Senate Resolution No. 10 (SR 10) Committee Recommendation #15

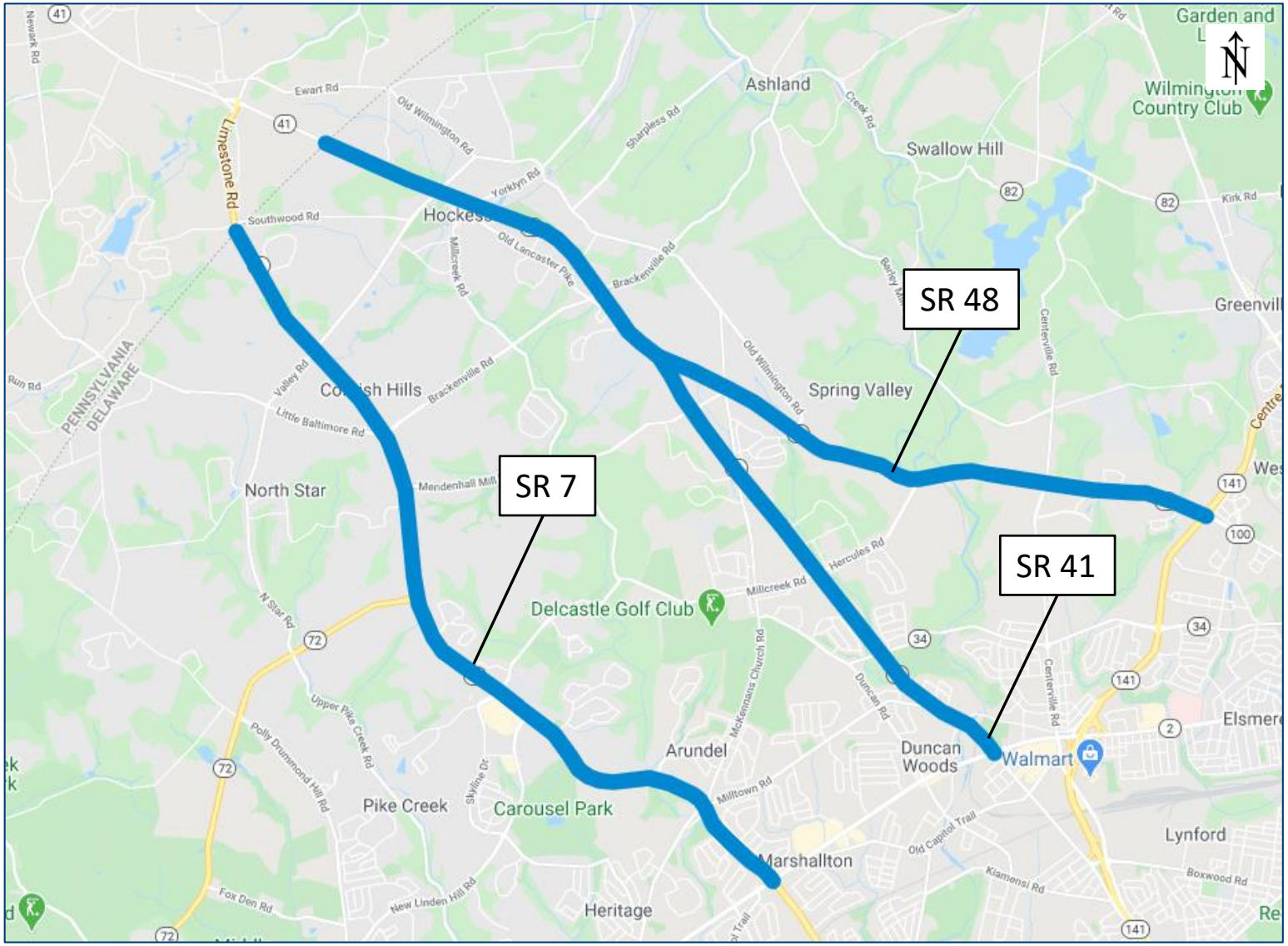
SR 7, SR 41, and SR 48 Corridors in New Castle County, Delaware

December 2020

DelDOT

WRA

Full Study Area



Full Study Area

- SR 7 Corridor
  - PA State Line to SR 2 (Kirkwood Highway)
  - 6.0-mile Other Principal Arterial
  - 13 signalized intersections; 7 intersections LOS D or worse
  - 28,968 to 38,968 corridor AADT
- SR 41 Corridor
  - PA State Line to SR 2 (Kirkwood Highway)
  - 6.0-mile Principal Arterial
  - 13 signalized intersections; 6 intersections LOS D or worse
  - 11,856 to 25,075 corridor AADT
- SR 48 Corridor
  - SR 41 to SR 141
  - 4.0-mile Principal Arterial
  - 6 signalized intersections; 4 intersections LOS D or worse
  - 13,506 to 32,831 corridor AADT

Travel Time Data and Signal Timing Final Reports included in Appendix A & B

Objective
"Top 5" Intersections

SR 10 Committee Recommendation #15

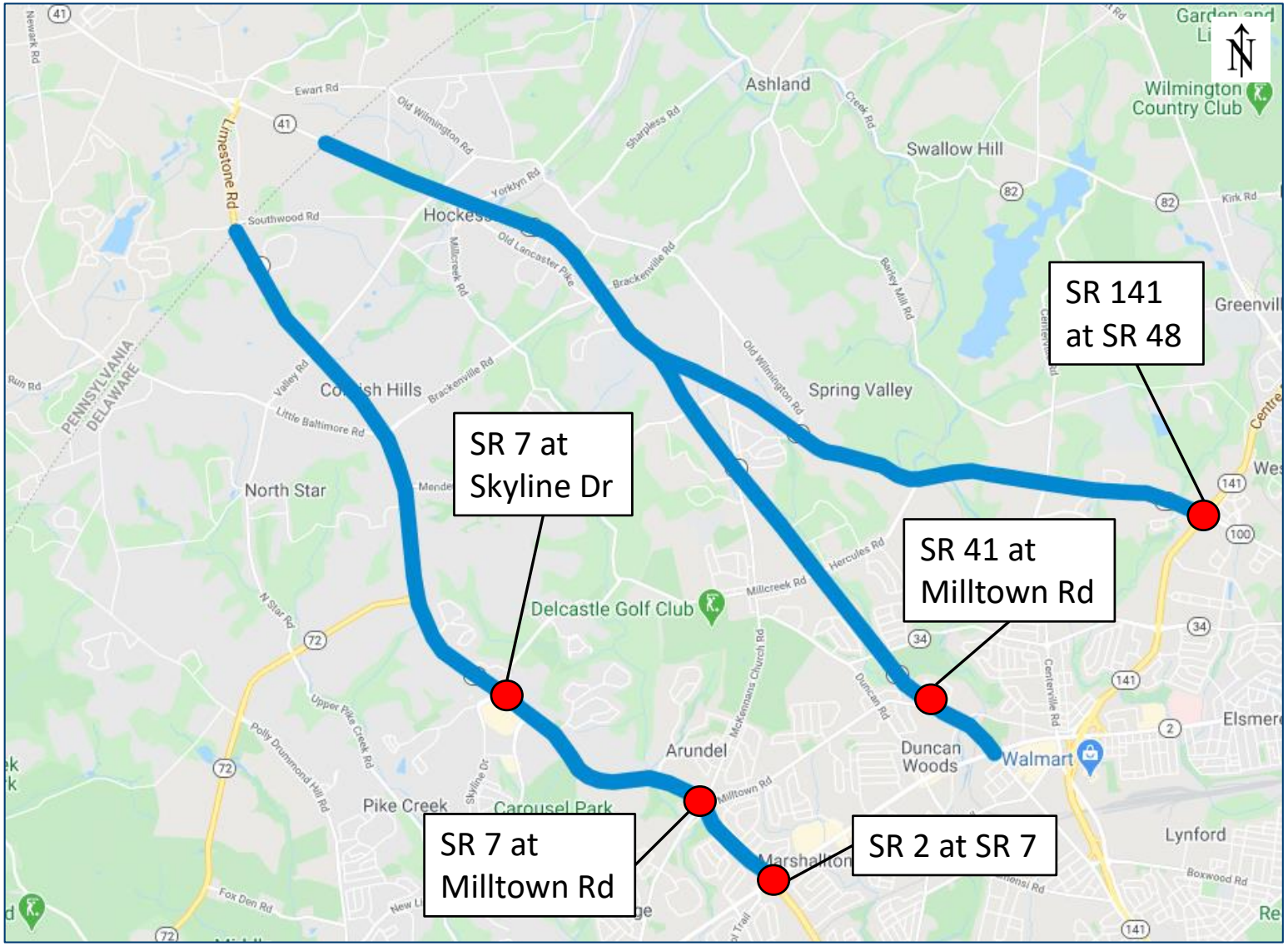
Perform a traffic engineering study to determine any potential improvements for intersections on SR 7, SR 41 and SR 48 that are currently operating at LOS E or worse, based on WILMAPCO's Congestion Management Program Results

- WILMAPCO identified "Top 5" intersections along SR 7/41/48 that currently operate at LOS E or worse
- DelDOT subsequently analyzed improvements to decrease intersection delay and to operate at LOS D or better*
- DelDOT subsequently studied feasibility and construction impacts

*current volumes; no growth/forecasting

Recommendation #15

"Top 5" Intersections



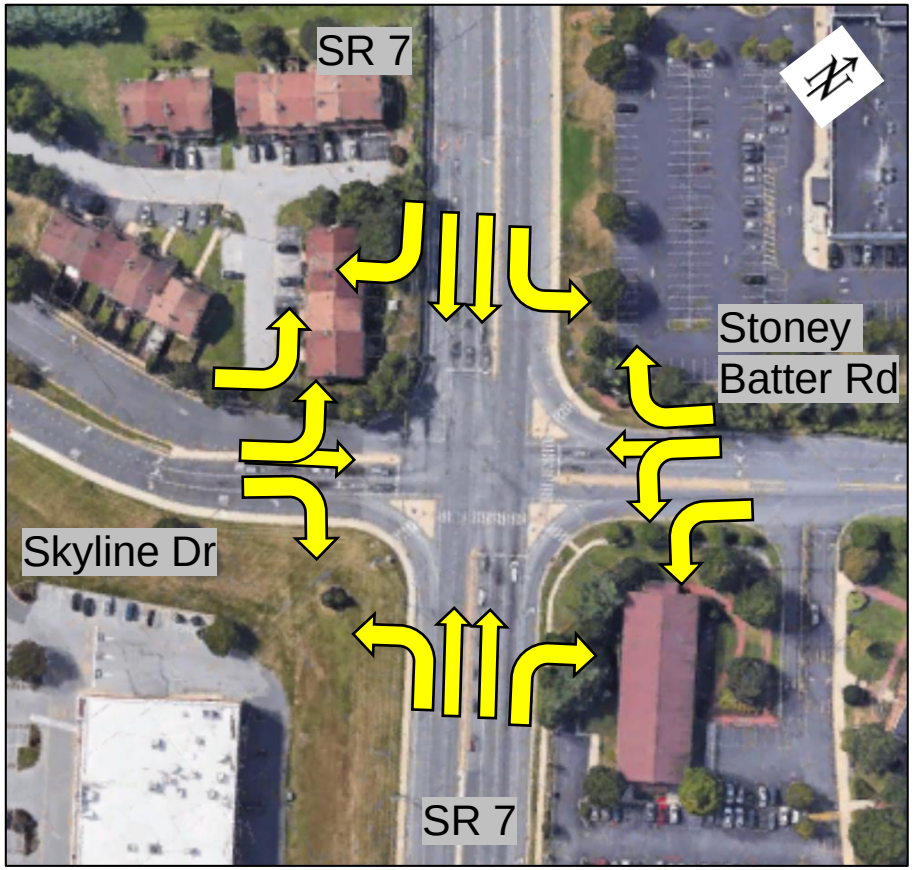
SR 7 at Skyline Drive

WILMAPCO LOS: E

Existing Delay / Level of Service (Synchro)

AM – 47.0 seconds / D

PM – 62.8 seconds / E



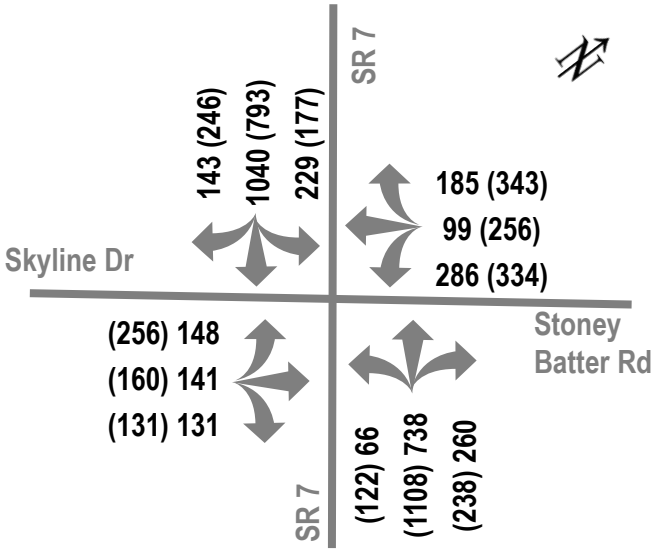
Existing Lane Configuration

Existing Conditions

NB / SB SR 7 Lefts Protected-Only

Split Side-Street Phasing

2020 HEP Rank #175



Peak Hour Turning Movement Volumes
Wednesday, October 18, 2017
AM (PM)

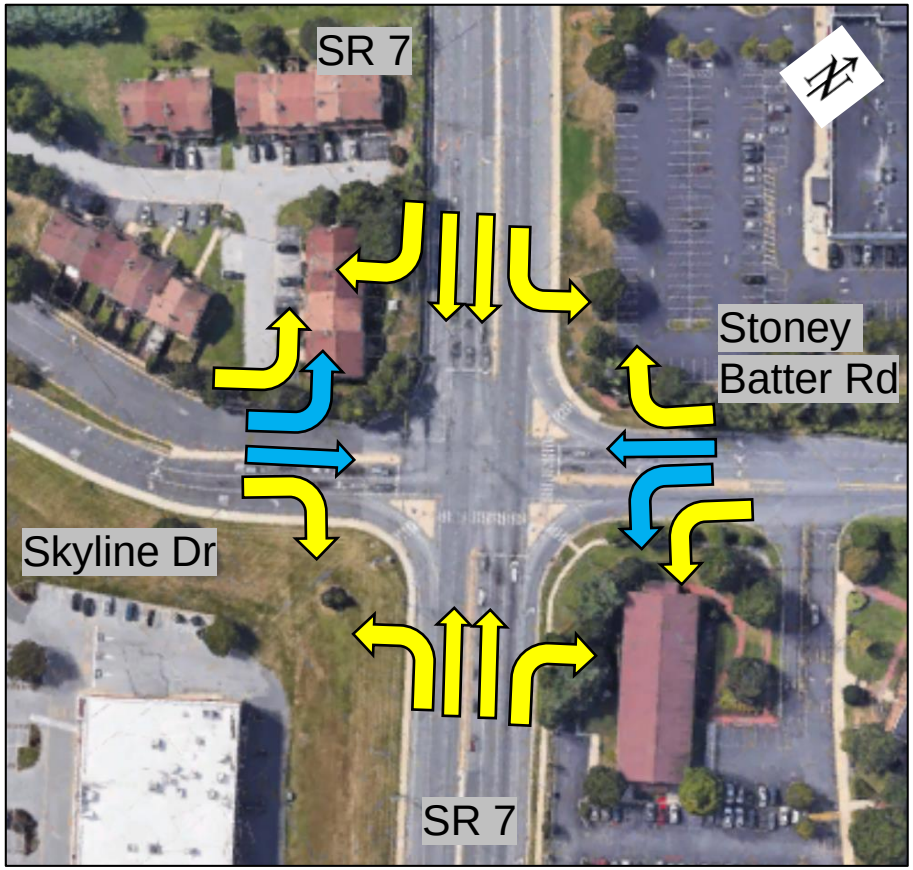
SR 7 at Skyline Drive

Reconfiguration Required to Achieve LOS D or Better

“Acceptable” Delay / Level of Service (Synchro)

AM – 41.7 seconds / D

PM – 45.2 seconds / D

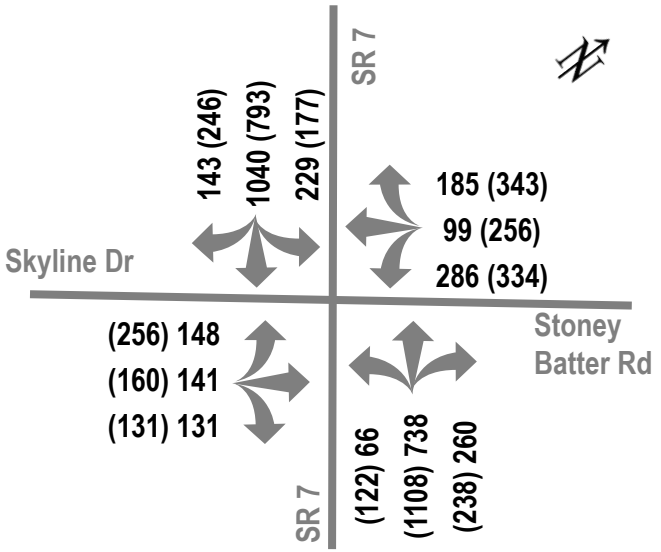


“Acceptable” Lane Configuration

“Acceptable” Conditions

Likely requires no right-of-way acquisition

See Alternatives 1A & 1B

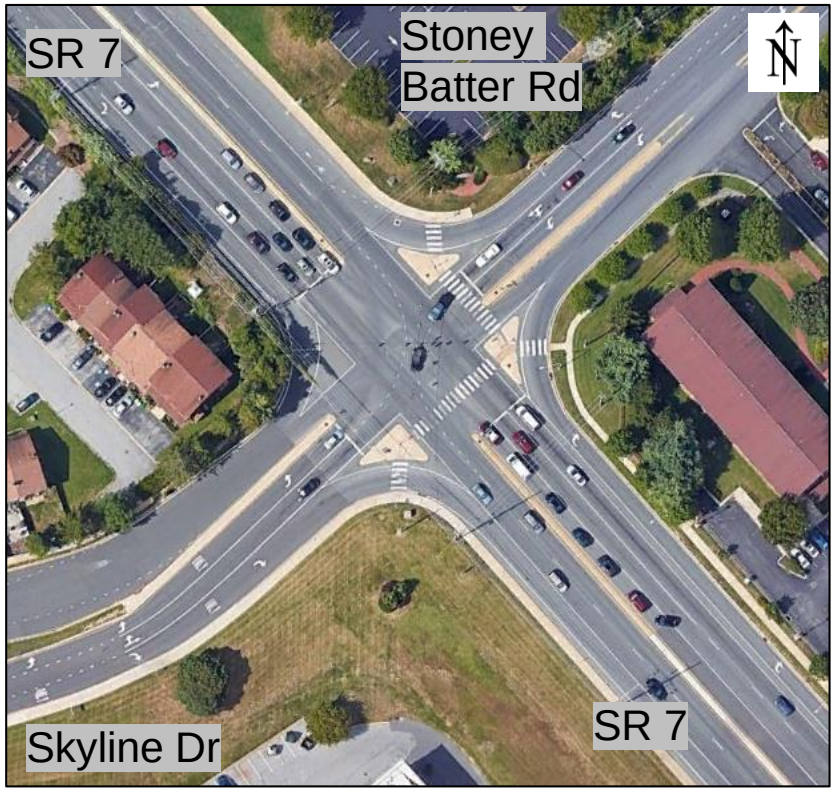


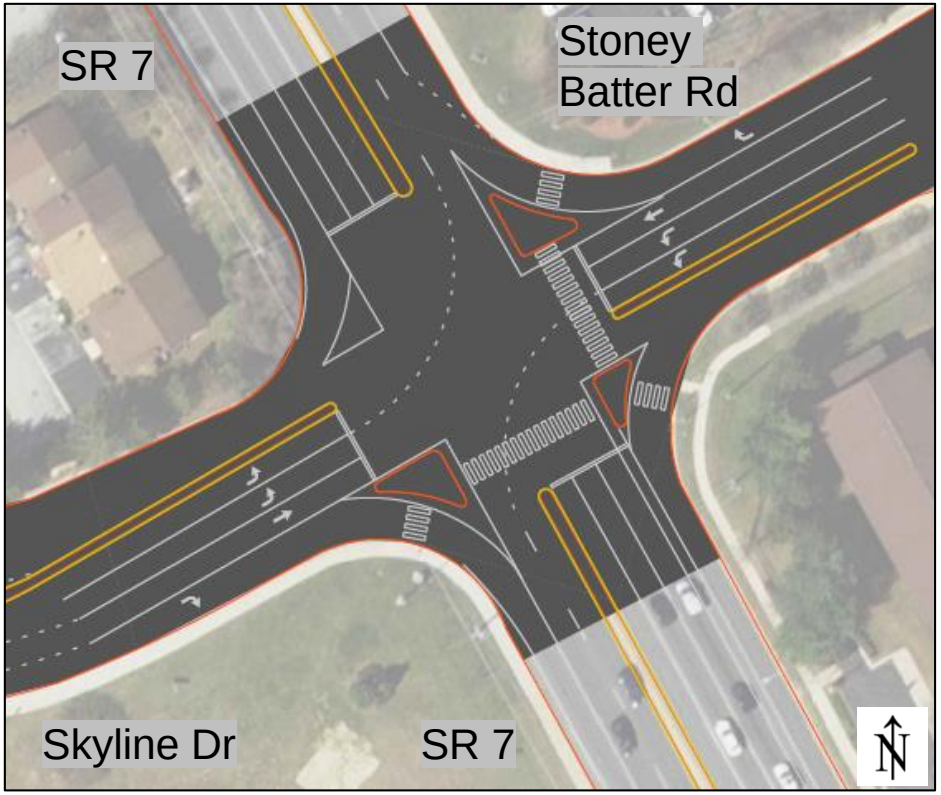
Peak Hour Turning Movement Volumes
Wednesday, October 18, 2017
AM (PM)

SR 7 at Skyline Drive

Alternative 1: Reconstruct EB and WB approaches

- Allows for split (1A) or concurrent (1B) side-street phasing
- Likely requires no additional right-of-way
- Reduces intersection delay during all peak periods
- Restriping to better utilize excess receiving lanes



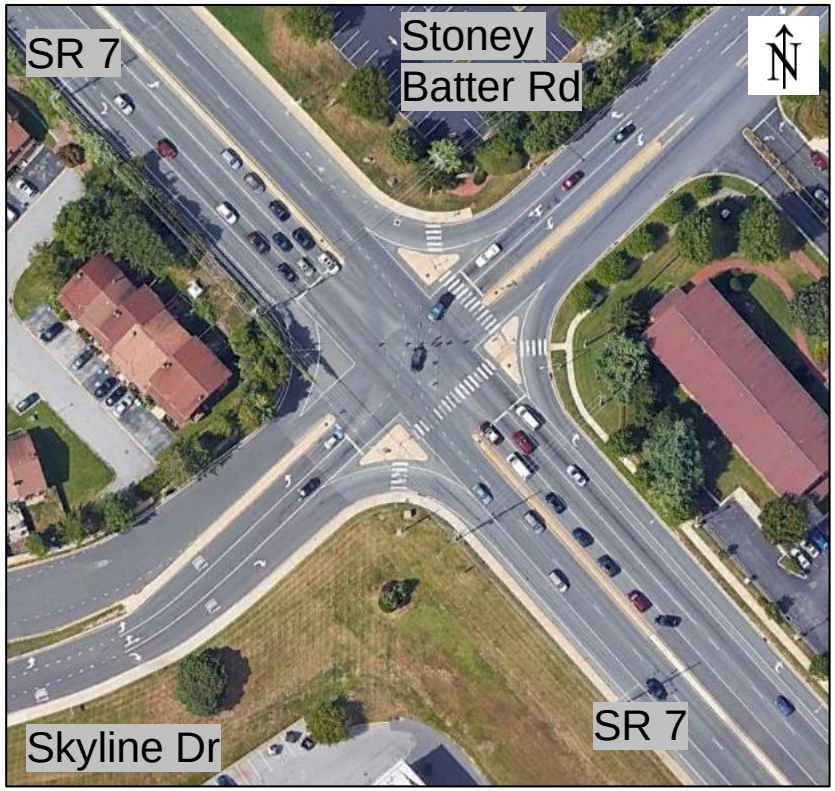


SR 7 at Skyline Drive

Alternative 1A: Retain Split Phasing

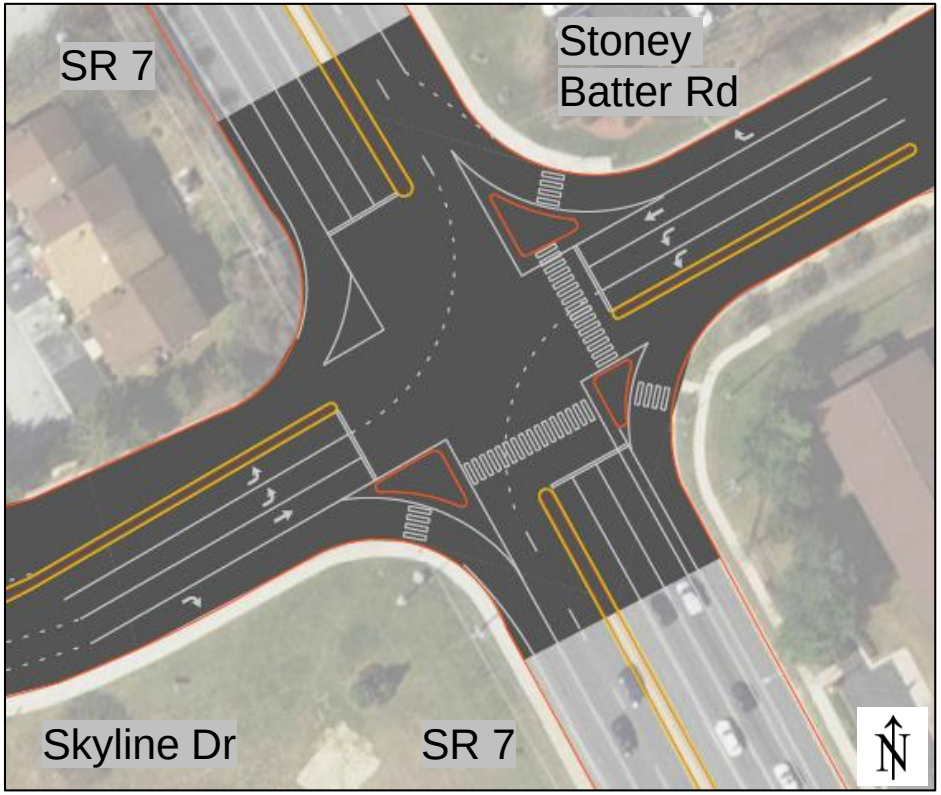
Existing Delay / Level of Service

	NB SR 7	SB SR 7	EB Skyline Dr	WB Stoney Batter Rd	Intersection
AM	54.3 s / D	37.4 s / D	52.8 s / D	53.2 s / D	47.0 s / D
PM	82.7 s / F	39.0 s / D	56.0 s / E	66.5 s / E	62.8 s / E



Split Phasing Delay / Level of Service

	NB SR 7	SB SR 7	EB Skyline Dr	WB Stoney Batter Rd	Intersection
AM	33.7 s / C	32.5 s / C	49.8 s / D	50.1 s / D	37.8 s / D
PM	46.7 s / D	37.3 s / C	50.1 s / D	57.3 s / E	46.8 s / D

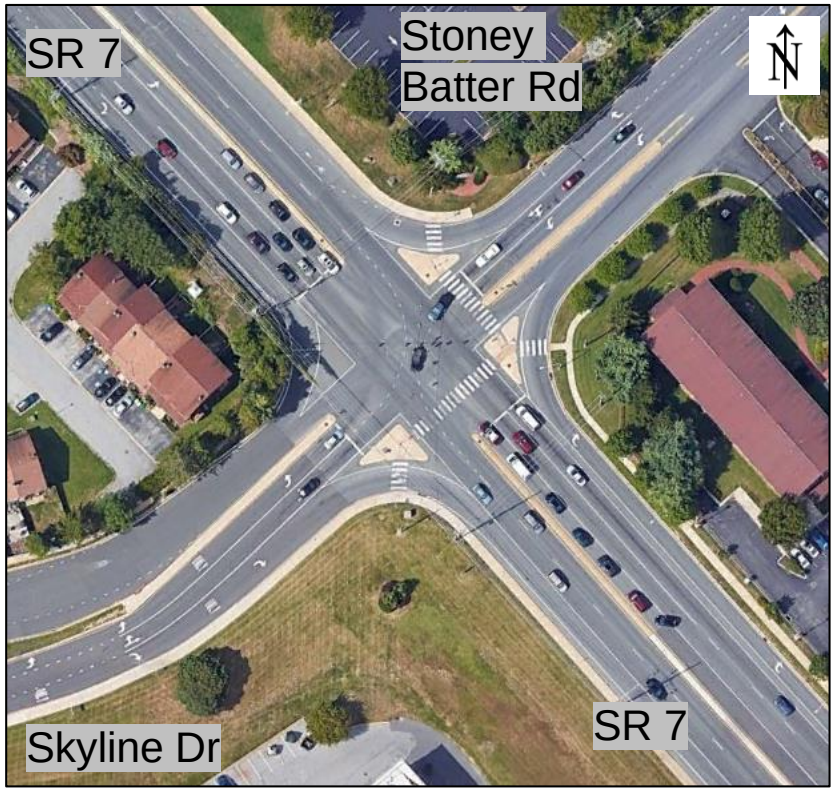


SR 7 at Skyline Drive

Alternative 1B: Concurrent Side-Street Phasing

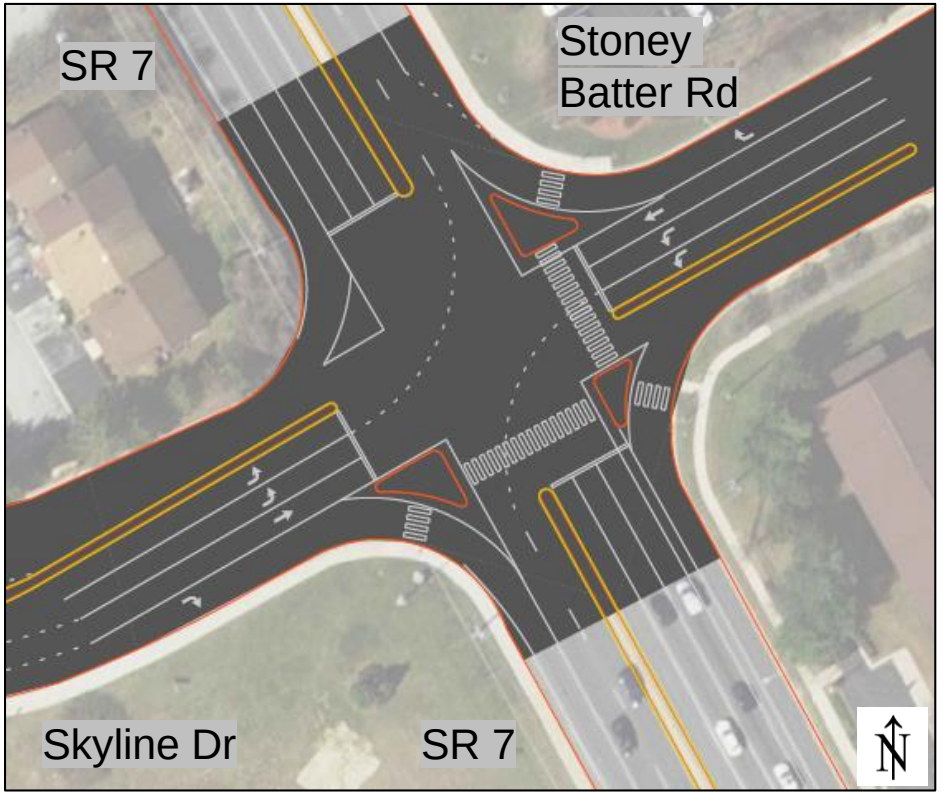
Existing Delay / Level of Service

	NB SR 7	SB SR 7	EB Skyline Dr	WB Stoney Batter Rd	Intersection
AM	54.3 s / D	37.4 s / D	52.8 s / D	53.2 s / D	47.0 s / D
PM	82.7 s / F	39.0 s / D	56.0 s / E	66.5 s / E	62.8 s / E



Concurrent Phasing Delay / Level of Service

	NB SR 7	SB SR 7	EB Skyline Dr	WB Stoney Batter Rd	Intersection
AM	31.5 s / C	30.5 s / C	47.4 s / D	39.6 s / D	34.4 s / C
PM	41.6 s / D	35.8 s / D	41.3 s / D	45.7 s / D	40.8 s / D



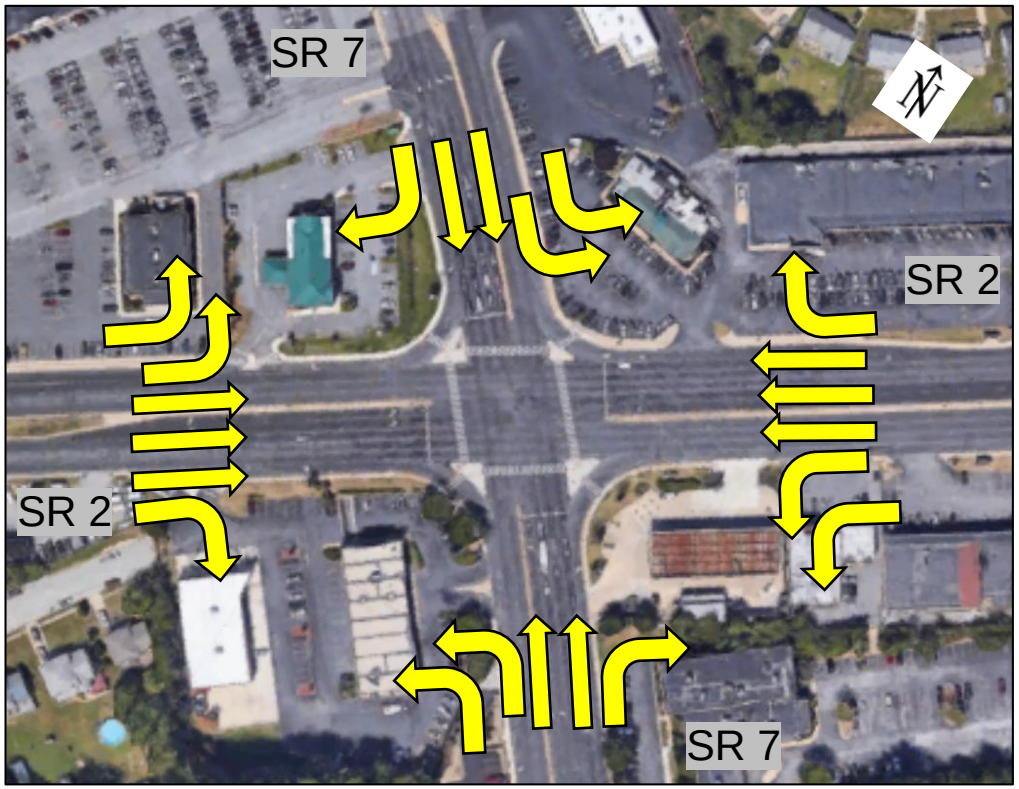
SR 2 at SR 7

WILMAPCO LOS: F

Existing Delay / Level of Service (Synchro)

AM – 62.0 seconds / E

PM – 68.3 seconds / E



Existing Lane Configuration

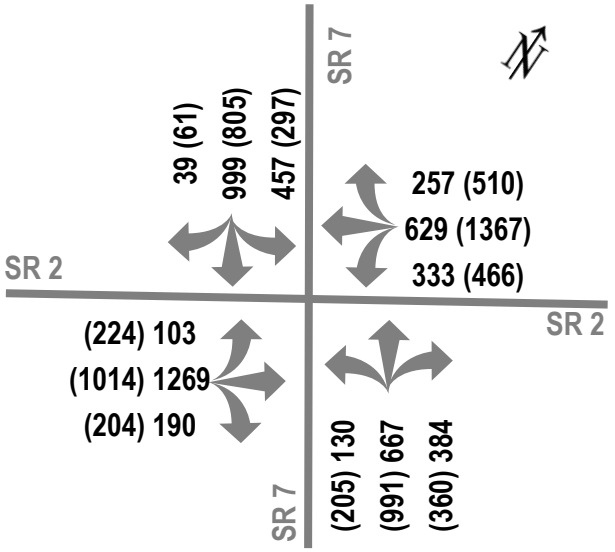
Existing Conditions

EB / WB SR 2 Lefts Protected-Only

NB / SB SR 7 Lefts Protected-Only

Concurrent Side-Street Phasing

2020 HEP Rank #1



Peak Hour Turning Movement Volumes
Wednesday, November 7, 2018
AM (PM)

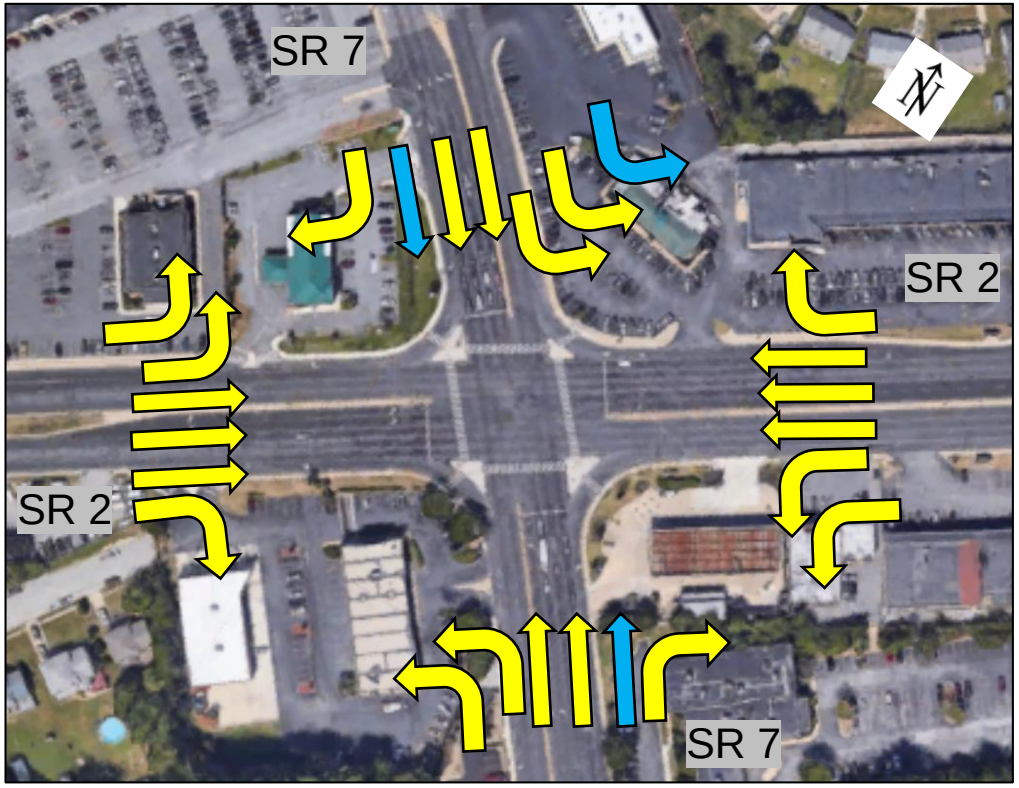
SR 2 at SR 7

Reconfiguration Required to Achieve LOS D or Better

"Acceptable" Delay / Level of Service (Synchro)

AM – 51.1 seconds / D

PM – 53.2 seconds / D

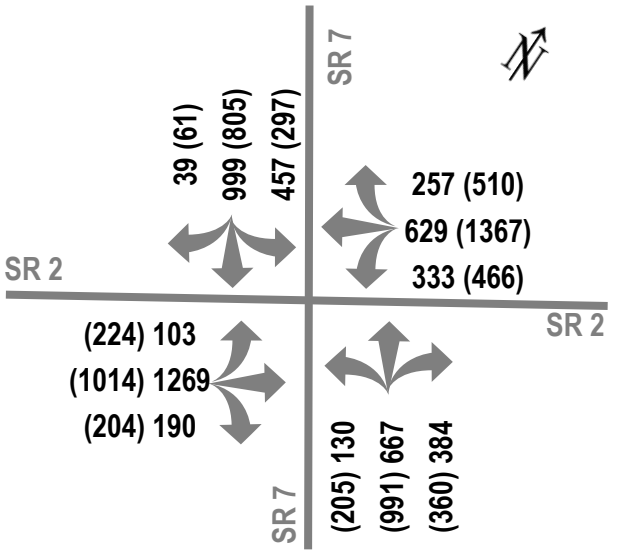


"Acceptable" Lane Configuration

"Acceptable" Conditions

Likely requires significant right-of-way acquisition

No further analysis of lane additions only recommended



Peak Hour Turning Movement Volumes
Wednesday, November 7, 2018
AM (PM)

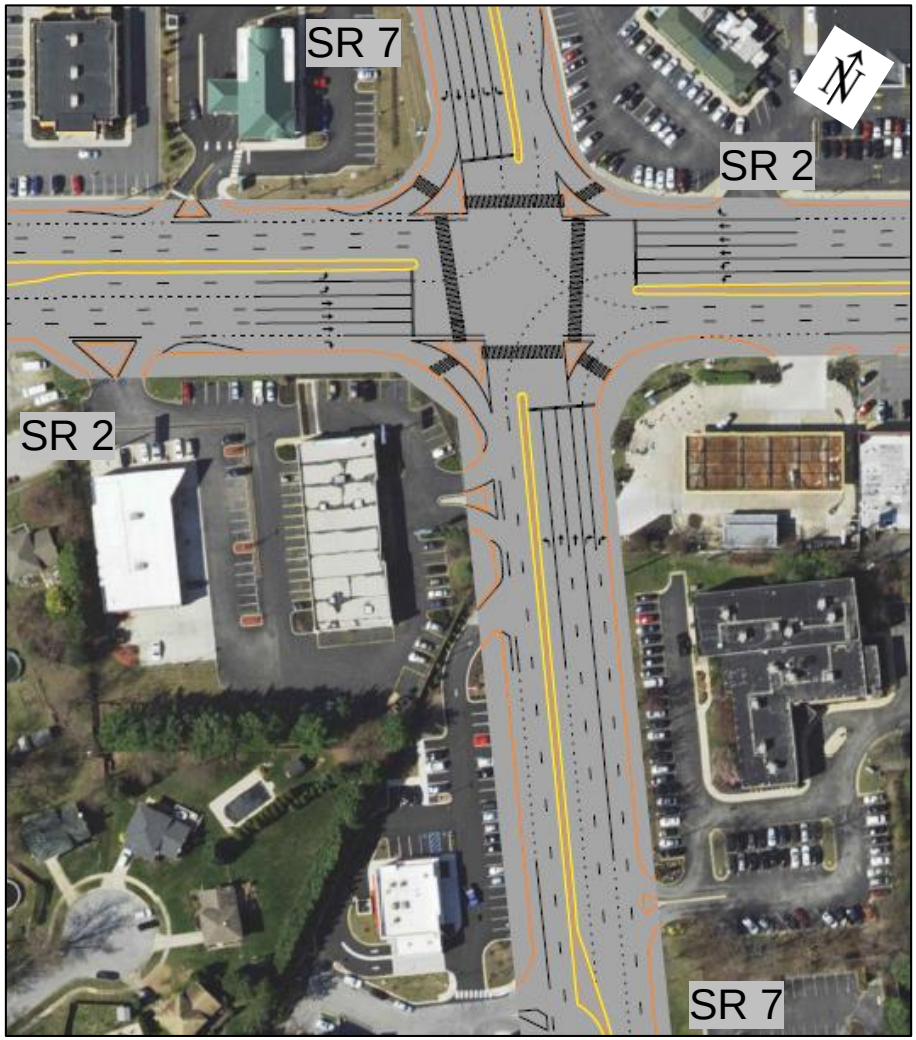
SR 2 at SR 7

Alternative 1: Reconstruct NB SR 7 approach (SR 2 PAR Public Workshop Feedback)

- Provides an additional NB R lane
- Requires NB R to be signalized
- Reduces NB L to a single lane
- Likely requires no additional right-of-way

Delay / LOS		NB L SR 7	NB R SR 7	Intersection
Existing	AM	68.8 s / E	65.5 s / E	62.0 s / E
	PM	79.5 s / E	41.3 s / D	68.3 s / E
Alternative 1	AM	94.9 s / F	33.6 s / C	62.7 s / E
	PM	306.8 s / F	19.4 s / B	74.4 s / E

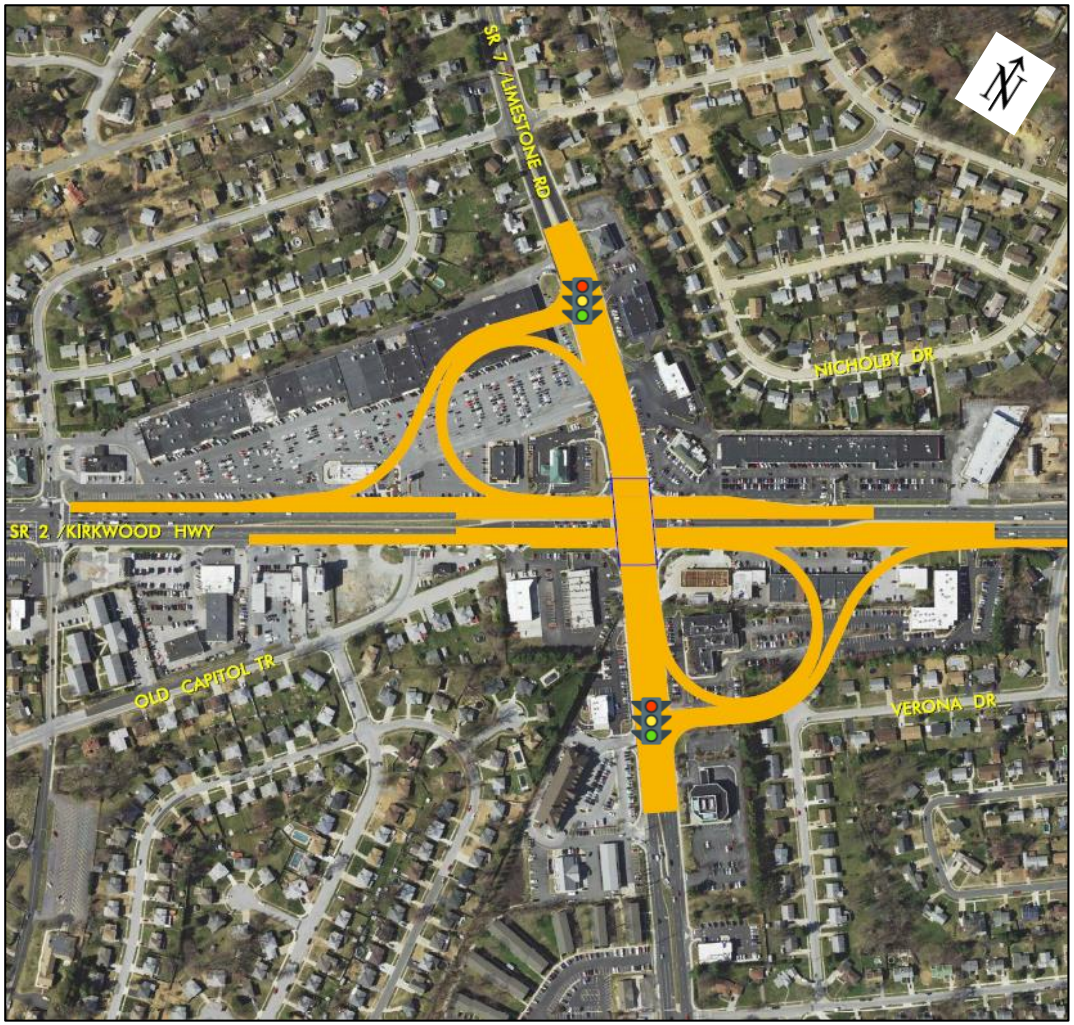
*Not recommended to further study due to delays



SR 2 at SR 7

Alternative 2: Grade Separated Intersection

- Requires significant right-of-way acquisition
- SR 7 elevated over SR 2
- Introduces new signalized intersections



*Not recommended to further study due to impacts

SR 2 at SR 7

Alternative 3: Continuous Flow

- Adds two new signalized intersections on SR 2
- Requires precise coordination of signals due to proximity
- Reduces number of phases and conflicts at the existing SR 2 at SR 7 signal
- Provides the ability to shorten cycle lengths
- NB R and SB R converted to “slip lanes”
- Requires additional right-of-way

SR 2 at SR 7

Alternative 3: Continuous Flow

Delay / LOS		SR 7 NB	SR 7 SB	SR 2 EB	SR 2 WB	SR 2 EB L	SR 2 WB L	Intersection
Existing	AM	71.6 s / E	66.3 s / E	58.1 s / E	52.5 s / D	74.9 s / E	97.5 s / F	62.0 s / E
	PM	65.5 s / E	81.8 s / F	63.6 s / E	66.5 s / E	75.6 s / E	80.3 s / F	68.3 s / E
Alt 3	AM	58.8 s / E	54.1 s / D	34.2 s / C	28.4 s / C	68.8 s / E	68.0 s / E	44.9 s / D
	PM	53.1 s / D	47.5 s / D	35.3 s / D	40.7 s / D	69.2 s / E	65.9 s / E	44.2 s / D

SR 2 at SR 7

Alternative 4: Center Turn Overpass (“Elevated Lefts”)

- Adds a signalized overpass for all left turns
- Reduces all left turns to single lanes
- Reduces number of phases and conflicts
- Provides the ability to shorten cycle lengths
- Minimizes roadway footprint

SR 2 at SR 7

Alternative 4: Center Turn Overpass (“Elevated Lefts”)

Delay / LOS		SR 7 NB	SR 7 SB	SR 2 EB	SR 2 WB	SR 2 EB L	SR 2 WB L	SR 7 NB L	SR 7 SB L	Intersection
Existing	AM	71.6 s / E	66.3 s / E	58.1 s / E	52.5 s / D	74.9 s / E	97.5 s / F	N/A	N/A	62.0 s / E
	PM	65.5 s / E	81.8 s / F	63.6 s / E	66.5 s / E	75.6 s / E	80.3 s / F	N/A	N/A	68.3 s / E
Alt 4	AM	39.3 s / D	44.7 s / D	23.2 s / C	19.8 s / B	9.5 s / A	11.1 s / B	16.9 s / B	27.5 s / C	31.4 s / C 19.0 s / B*
	PM	45.2 s / D	39.1 s / D	21.3 s / C	25.6 s / C	6.6 s / A	7.7 s / A	24.6 s / C	30.6 s / C	31.8 s / C 16.1 s / B*

*Elevated Lefts Intersection

SR 7 at Milltown Road

WILMAPCO LOS: F

Existing Delay / Level of Service (Synchro)

AM – 65.1 seconds / E (SR 7)

44.1 seconds / D (McKennans Church Rd)

PM – 90.6 seconds / F (SR 7)

49.5 seconds / D (McKennans Church Rd)

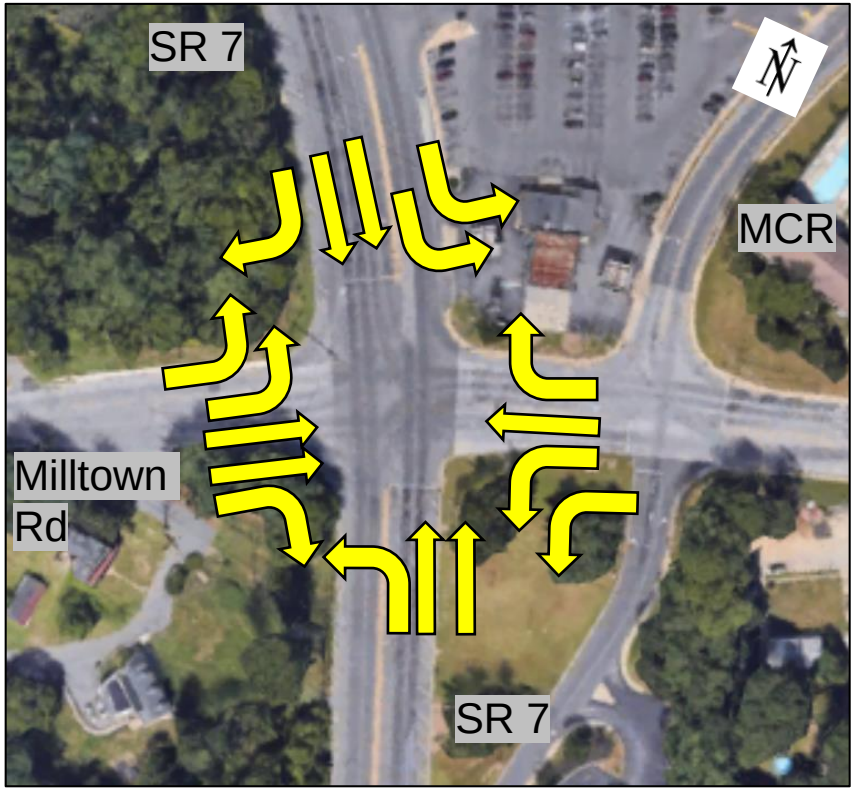
Existing Conditions

NB / SB SR 7 Lefts Protected-Only

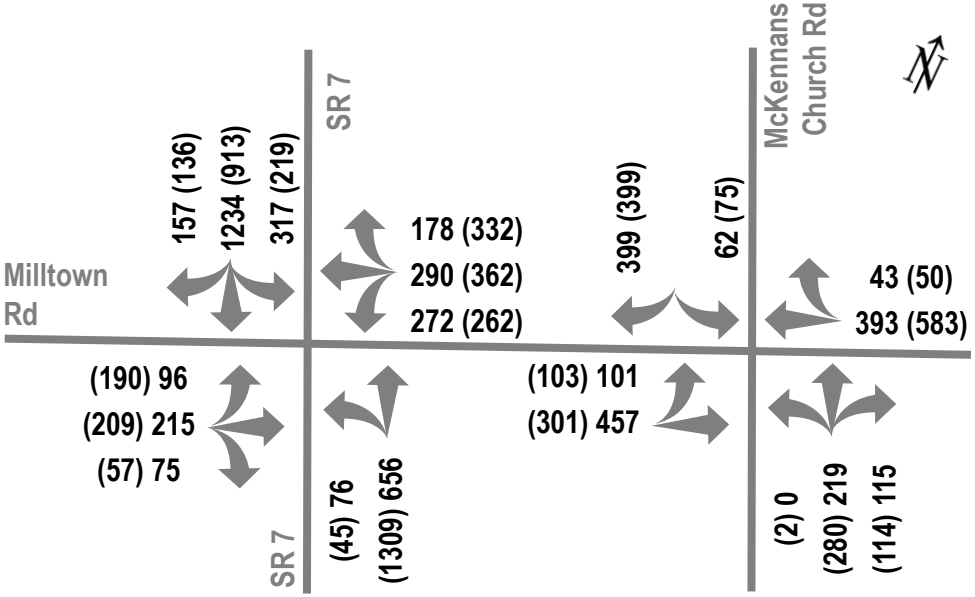
EB / WB Milltown Rd Lefts Protected-Only

Concurrent Side-Street Phasing

2020 HEP Rank #139



Existing Lane Configuration



Peak Hour Turning Movement Volumes
Thursday, November 8, 2018
AM (PM)

SR 7 at Milltown Road

Reconfiguration Required to Achieve LOS D or Better

"Acceptable" Delay / Level of Service (Synchro)

AM – 41.3 seconds / D (SR 7)

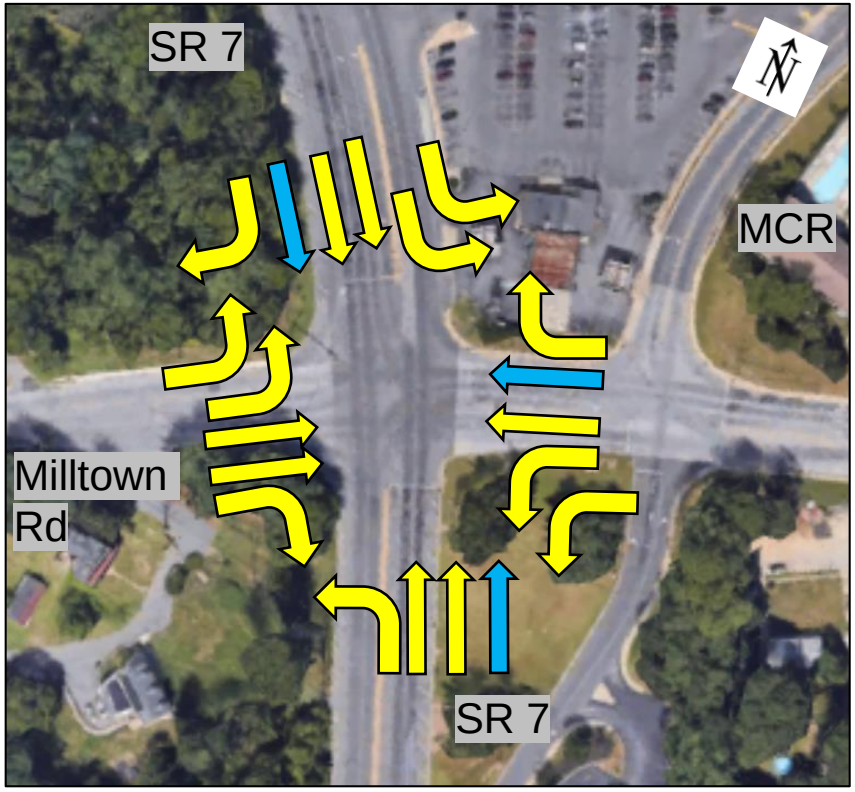
43.4 seconds / D (McKennans Church Rd)

PM – 43.3 seconds / D (SR 7)

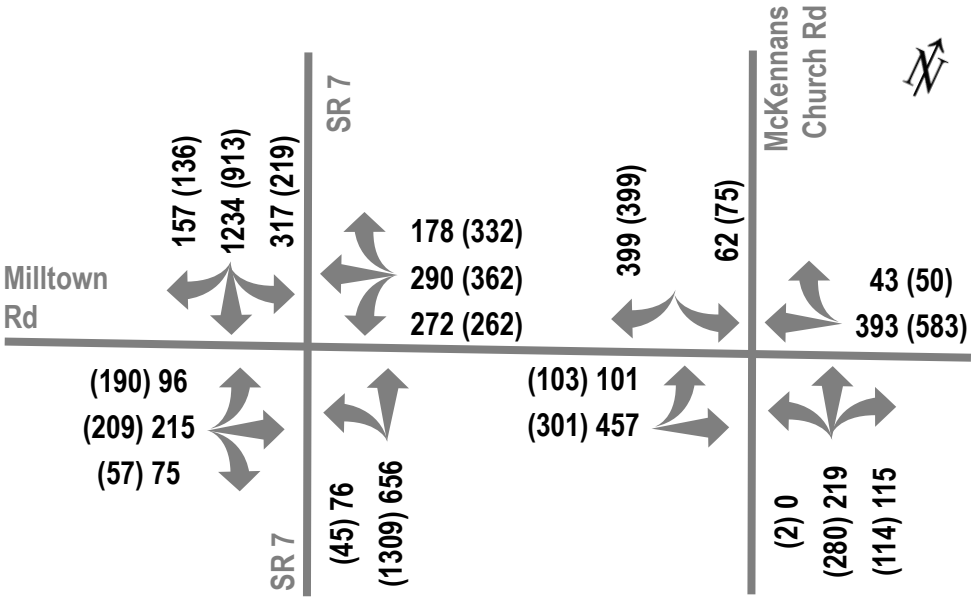
47.4 seconds / D (McKennans Church Rd)

"Acceptable" Conditions

Likely requires right-of-way acquisition



"Acceptable" Lane Configuration

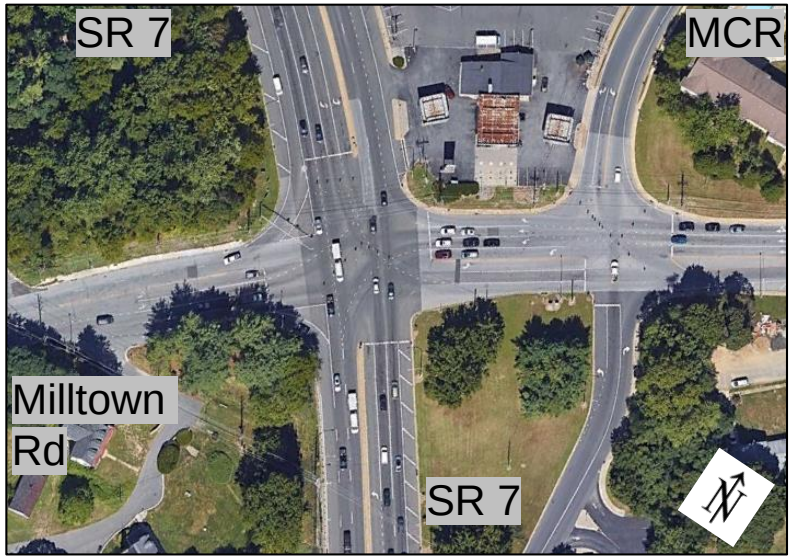


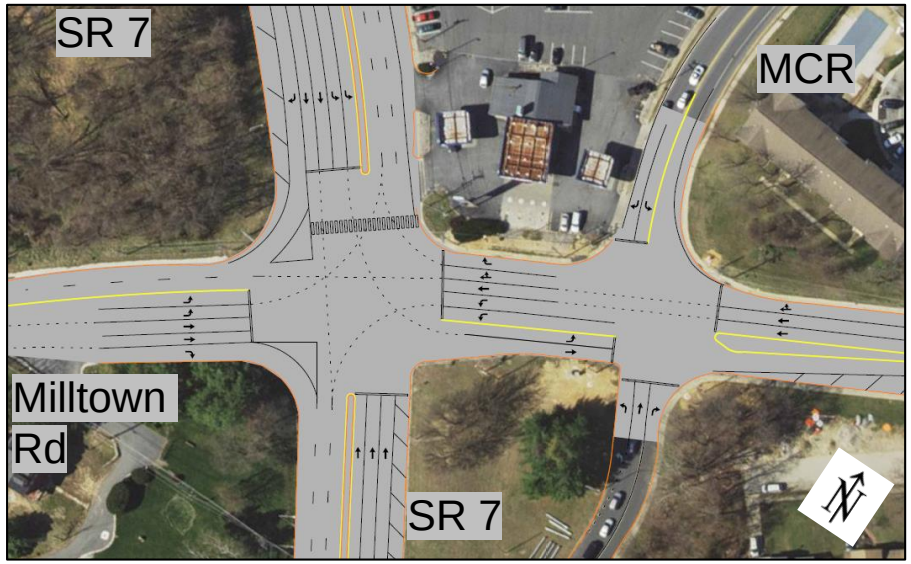
Peak Hour Turning Movement Volumes
Thursday, November 8, 2018
AM (PM)

SR 7 at Milltown Road

Alternative 1A: Restripe Milltown Rd Median & Reroute SR 7 NB Left Turn (Jughandle)

- Adds an additional NB T lane
- Adds an additional shared WB T/R lane (requires WB R signalization) (“Limestone Town Hall” public suggestion)
- Removes EB merge lane east of McKennans Church Rd (MCR)
- Requires NB L vehicles to “jughandle” at the Milltown Rd / MCR intersection
- Reduces intersection delay during all peak periods
- Likely requires no additional right-of-way
- 76 AM and 45 PM NB L vehicles would reroute

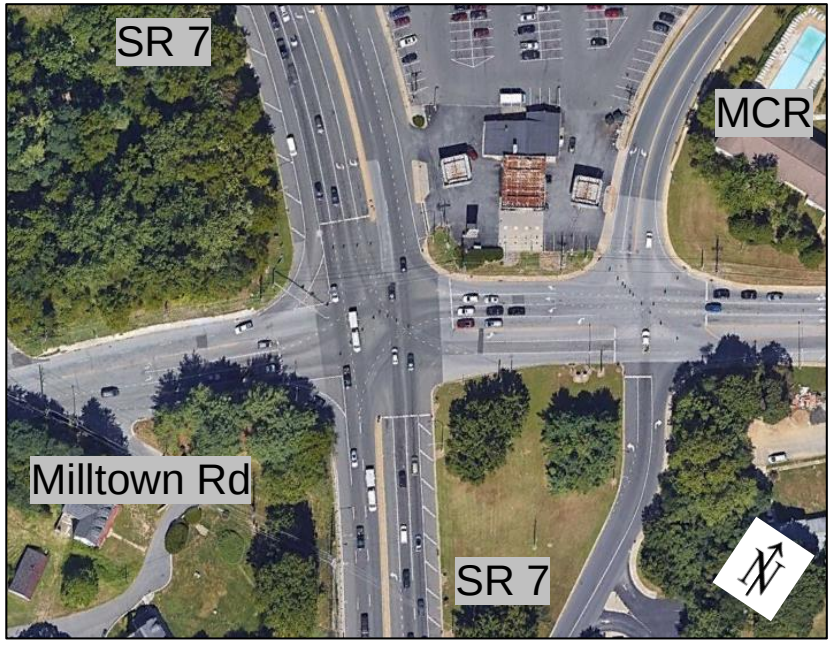


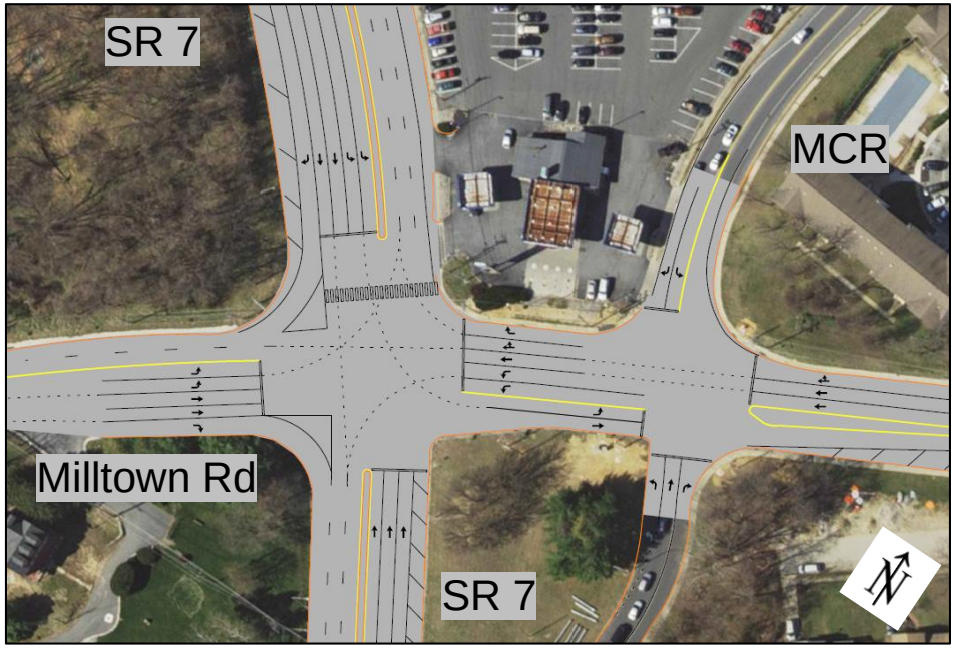


SR 7 at Milltown Road

Alternative 1A: Restripe Milltown Rd Median & Relocate SR 7 NB Left Turn

Delay / LOS		NB SR 7	SB SR 7	EB Milltown Rd @ SR 7	WB Milltown Rd @ SR 7	NB MCR	SB MCR	EB Milltown Rd @ MCR	WB Milltown Rd @ MCR	Intersection
Existing	AM	54.0 s / D	85.3 s / F	52.8 s / D	35.7 s / D	42.6 s / D	64.6 s / E	24.4 s / C	48.8 s / D	65.1 s / E 44.1 s / D
	PM	172.4 s / F	57.7 s / E	64.4 s / E	31.0 s / C	46.3 s / D	58.8 s / E	35.0 s / C	53.7 s / D	90.6 s / F 49.5 s / D
Alternative 1A	AM	47.1 s / D	57.7 s / E	52.8 s / D	38.4 s / D	44.8 s / D	61.4 s / E	64.1 s / E	48.8 s / D	50.8 s / D 55.6 s / E
	PM	59.5 s / E	47.9 s / D	64.4 s / E	37.1 s / D	45.2 s / D	56.5 s / E	35.6 s / D	53.7 s / D	50.8 s / D 48.7 s / D

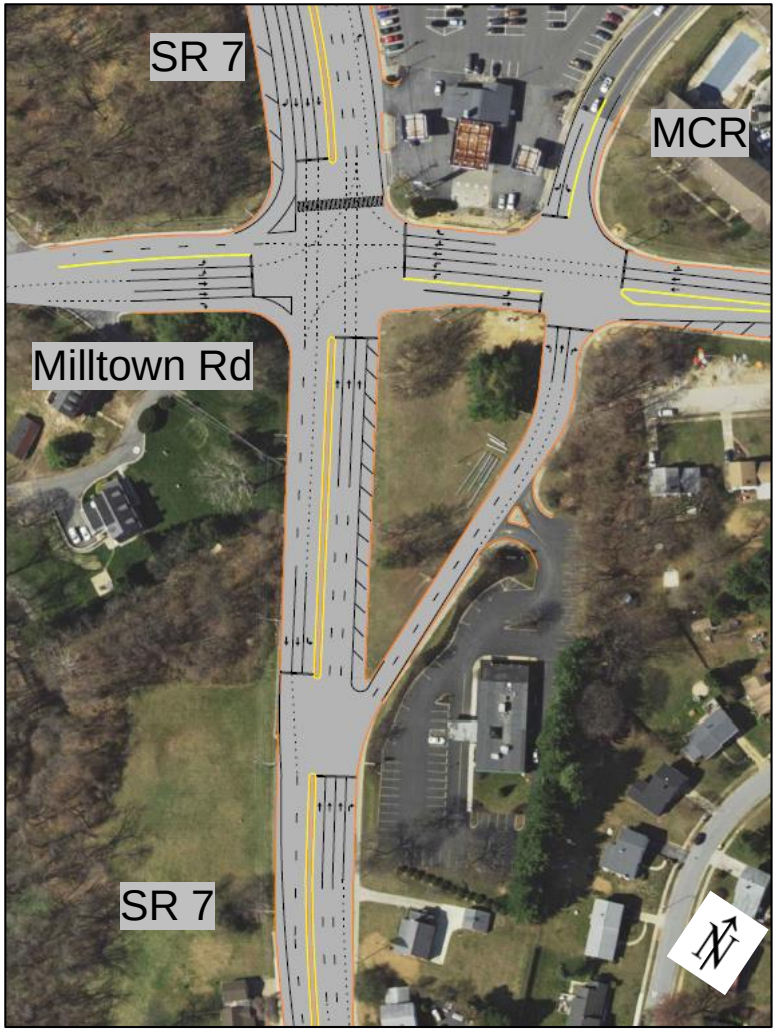




SR 7 at Milltown Road

Alternative 1B: Alt 1A + Relocate SR 7 SB Left Turn (New Half Signal)

- Alternative 1A with new signalized intersection on SR 7 south of Milltown Rd
- Adds an additional SB T lane
- Likely requires no additional right-of-way
- May create unwanted vehicle travel through shopping center as “cut-thru” path
- SB L queues and signal coordination must be monitored in field to prevent blocking and safety issues
- 317 AM and 219 PM SB L vehicles would reroute

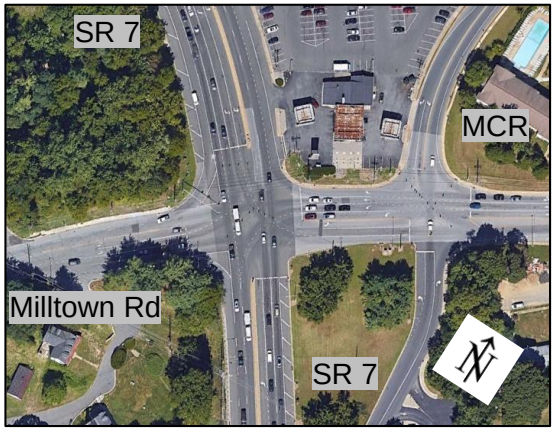


SR 7 at Milltown Road

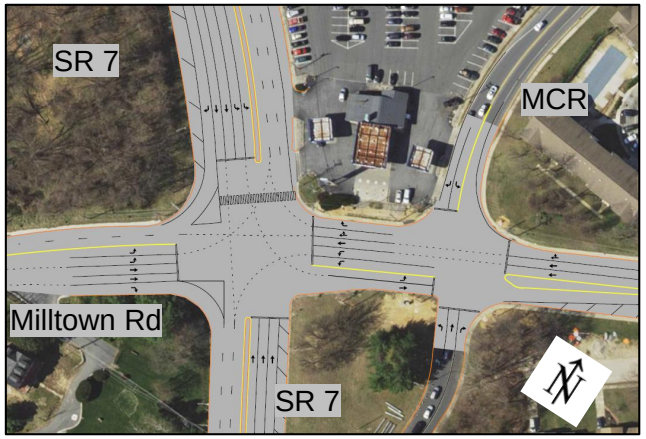
Alternatives 1A & 1B: Restriping / Left-Turn Relocation

Delay / LOS		NB SR 7	SB SR 7	EB Milltown Rd @ SR 7	WB Milltown Rd @ SR 7	NB MCR	SB MCR	EB Milltown Rd @ MCR	WB Milltown Rd @ MCR	Intersection
Existing	AM	54.0 s / D	85.3 s / F	52.8 s / D	35.7 s / D	42.6 s / D	64.6 s / E	24.4 s / C	48.8 s / D	65.1 s / E 44.1 s / D
	PM	172.4 s / F	57.7 s / E	64.4 s / E	31.0 s / C	46.3 s / D	58.8 s / E	35.0 s / C	53.7 s / D	90.6 s / F 49.5 s / D
Alternative 1A	AM	47.1 s / D	57.7 s / E	52.8 s / D	38.4 s / D	44.8 s / D	61.4 s / E	64.1 s / E	48.8 s / D	50.8 s / D 55.6 s / E
	PM	59.5 s / E	47.9 s / D	64.4 s / E	37.1 s / D	45.2 s / D	56.5 s / E	35.6 s / D	53.7 s / D	50.8 s / D 48.7 s / D
Alternative 1B	AM	28.4 s / C	37.0 s / D	64.4 s / E	40.7 s / D	28.5 s / C	61.9 s / E	18.2 s / B	61.9 s / E	39.2 s / D 43.3 s / D
	PM	42.1 s / D	35.4 s / D	61.8 s / E	33.1 s / C	34.1 s / C	58.8 s / E	46.0 s / D	59.9 s / E	40.0 s / D 49.6 s / D

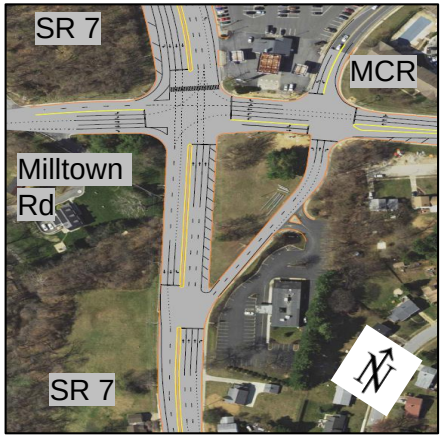
Existing



Alternative 1A



Alternative 1B

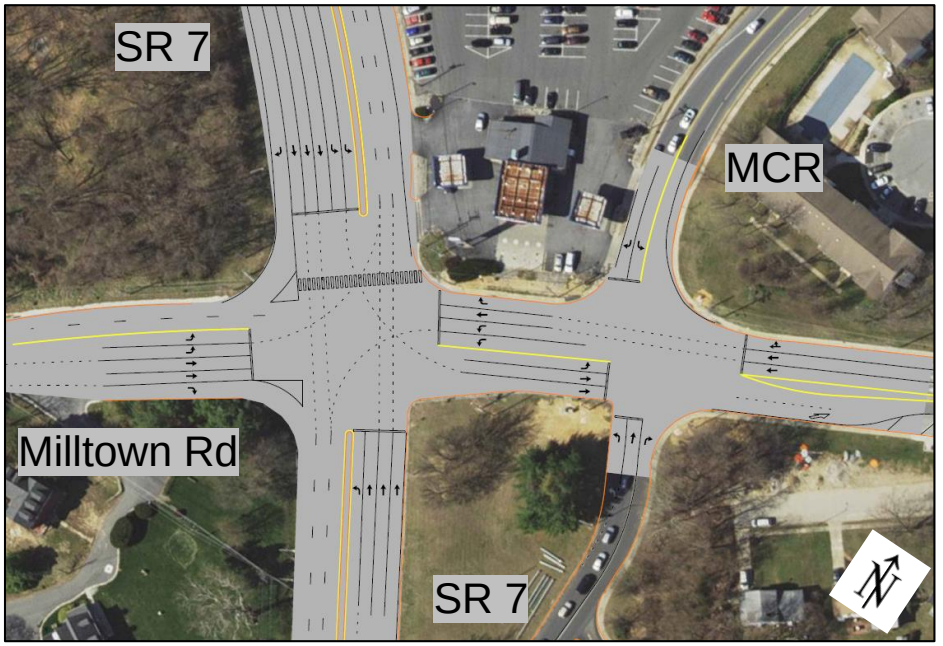


SR 7 at Milltown Road

Alternative 1C: Restripe SR 7

- Adds an additional thru lane NB and SB SR 7
- Reduces intersection delay during all peak periods
- Likely requires no additional right-of-way

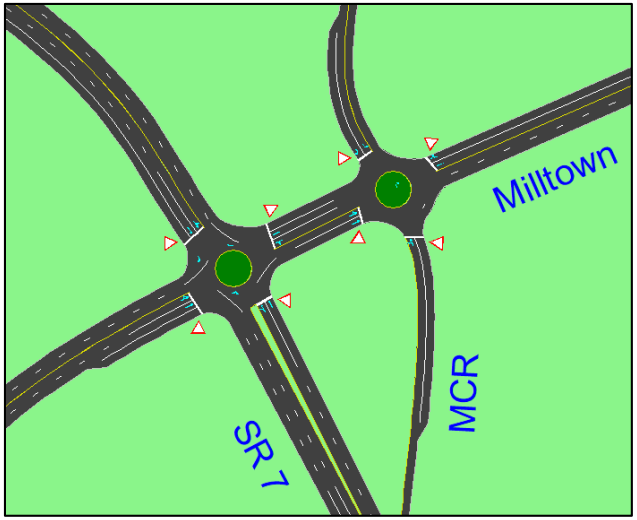
Delay / LOS		NB SR 7	SB SR 7	Intersection
Existing	AM	54.0 s / D	85.3 s / F	65.1 s / E
	PM	172.4 s / F	57.7 s / E	90.6 s / F
Alternative 1C	AM	49.6 s / D	58.8 s / E	51.5 s / D
	PM	60.8 s / E	51.7 s / D	51.3 s / D



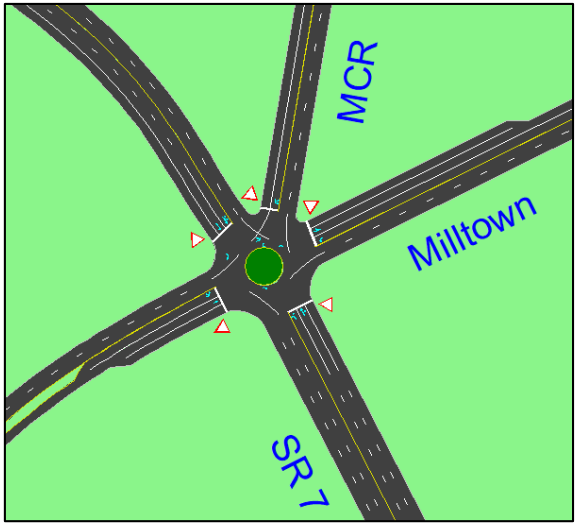
SR 7 at Milltown Road

Alternative 2: Roundabout ("Limestone Town Hall" Public Suggestion)

Alternative 2A: Two Roundabouts



Alternative 2B: Single 5-leg Roundabout



V/C Ratio		NB SR 7	SB SR 7	EB Milltown Rd @ SR 7	WB Milltown Rd @ SR 7	NB MCR	SB MCR	EB Milltown Rd @ MCR	WB Milltown Rd @ MCR
Alternative 2A – Two Roundabouts	AM	0.527	1.166	0.871	0.474	0.295	0.456	0.255	0.236
	PM	0.985	0.886	0.611	1.216	0.386	0.527	0.267	0.404
Alternative 2B – Single 5-leg Roundabout	AM	0.737	1.317	0.945	N/A	N/A	0.502	N/A	0.539
	PM	1.296	0.948	0.845	N/A	N/A	1.503	N/A	1.934

*Not recommended to study roundabout alternatives further; volume exceeds capacity by nearly 100%

SR 7 at Milltown Road

Alternative 3: Grade Separated Intersection

*Not recommended to study further due to impacts

- Requires significant right-of-way acquisition
- SR 7 elevated over Milltown Rd
- Existing Milltown Rd and MCR intersection to remain
- MCR south of Milltown Rd converted to two-way traffic (right-in, right-out only)
- Provides the ability to shorten cycle lengths
- Flyover ramp from SR 7 SB to Milltown Rd EB includes insufficient merge area

Delay / LOS		NB MCR	SB MCR	EB Milltown Rd @ MCR	WB Milltown Rd @ MCR	Intersection
Existing	AM	42.6 s / D	64.6 s / E	24.4 s / C	48.8 s / D	44.1 s / D
	PM	46.3 s / D	58.8 s / E	35.0 s / C	53.7 s / D	49.5 s / D
Alternative 3	AM	39.4. s / D	40.8 s / D	25.4 s / C	22.2 s / C	31.5 s / C
	PM	49.9 s / D	49.6 s / D	35.1 s / D	26.6 s / C	38.3 s / D

SR 7 at Milltown Road

Alternative 4: SR 7 Thru Overpass

- Minimizes impacts to adjacent properties
- SR 7 elevated over Milltown Rd
- Existing signalized intersections to remain
- Provides the ability to shorten cycle lengths

Delay / LOS		EB Milltown Rd @ SR 7	WB Milltown Rd @ SR 7	NB MCR	SB MCR	EB Milltown Rd @ MCR	WB Milltown Rd @ MCR	Intersection
Existing	AM	52.8 s / D	35.7 s / D	42.6 s / D	64.6 s / E	24.4 s / C	48.8 s / D	65.1 s / E 44.1 s / D
	PM	64.4 s / E	31.0 s / C	46.3 s / D	58.8 s / E	35.0 s / C	53.7 s / D	90.6 s / F 49.5 s / D
Alt 4	AM	51.4 s / D	18.1 s / B	49.6 s / D	31.4 s / C	4.4 s / A	30.1 s / C	34.1 s / C 26.9 s / C
	PM	57.2 s / E	16.6 s / B	49.8 s / D	30.6 s / C	9.7 s / A	36.8 s / D	31.9 s / C 30.7 s / C

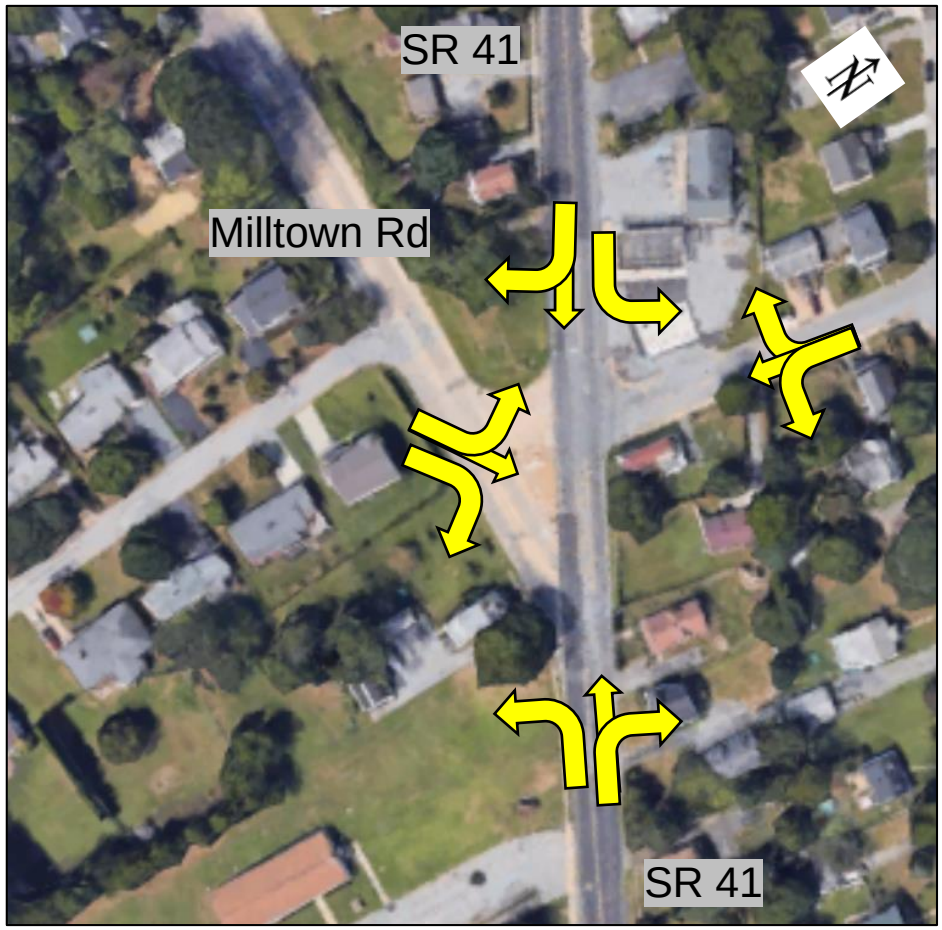
SR 41 at Milltown Road

WILMAPCO LOS: F

Existing Delay / Level of Service (Synchro)

AM – 20.3 seconds / C

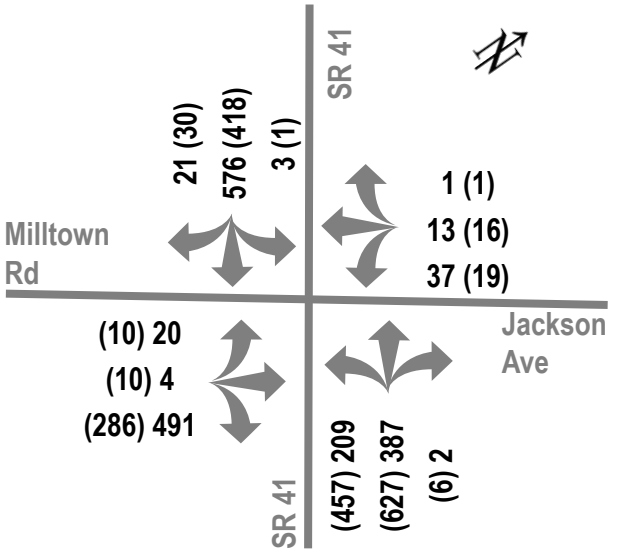
PM – 14.3 seconds / B



Existing Lane Configuration

***Existing lane configuration is considered acceptable**

2020 HEP Rank #298



Peak Hour Turning Movement Volumes
Tuesday, November 1, 2016
AM (PM)

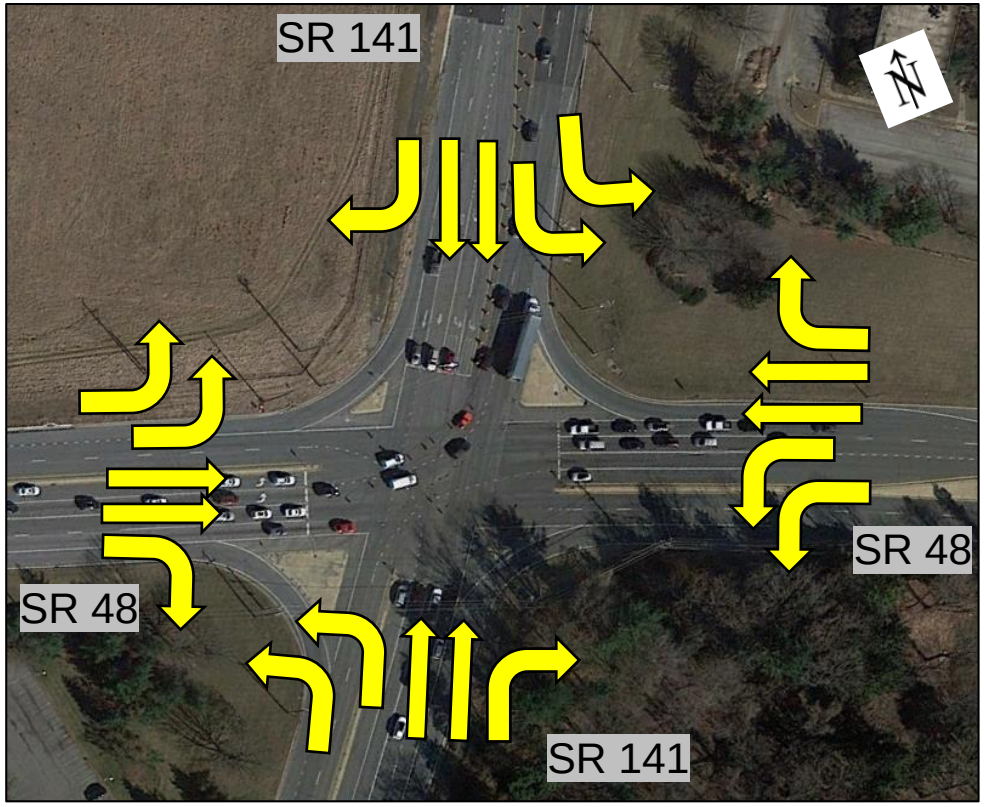
SR 141 at SR 48

WILMAPCO LOS: F

Existing Delay / Level of Service (Synchro)

AM – 84.2 seconds / F

PM – 98.6 seconds / F



Existing Lane Configuration

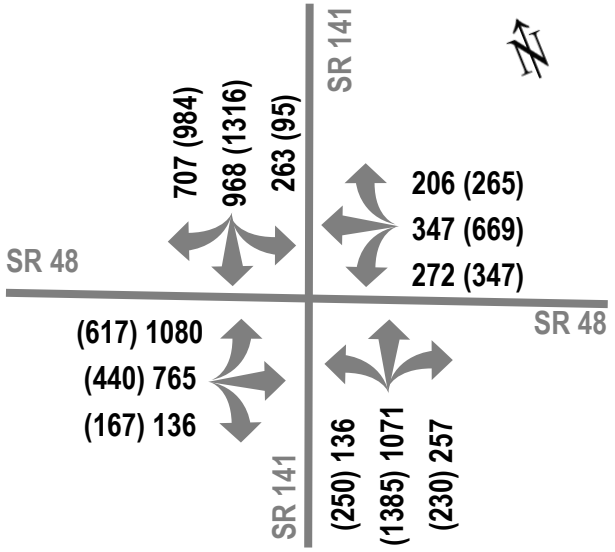
Existing Conditions

NB / SB SR 141 Lefts Protected-Only

EB / WB SR 48 Lefts Protected-Only

Concurrent Side-Street Phasing

2020 HEP Rank #28



Peak Hour Turning Movement Volumes
Wednesday, May 17, 2017
AM (PM)

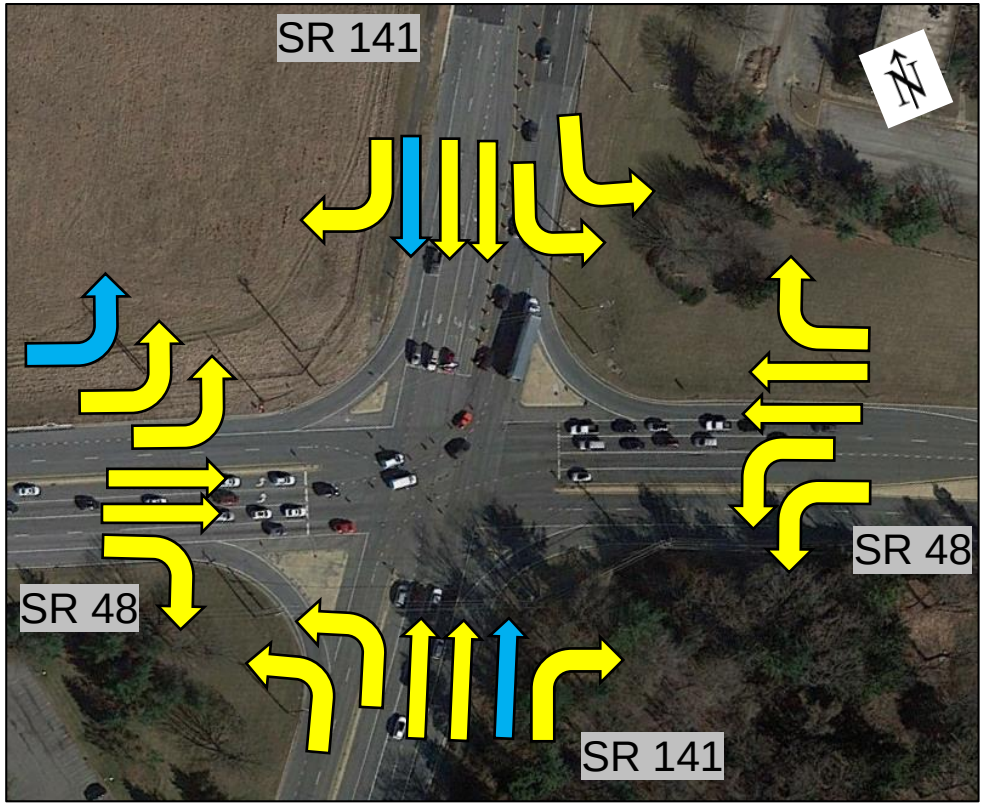
SR 141 at SR 48

Reconfiguration Required to Achieve LOS D or Better

“Acceptable” Delay / Level of Service (Synchro)

AM – 50.7 seconds / D

PM – 53.2 seconds / D

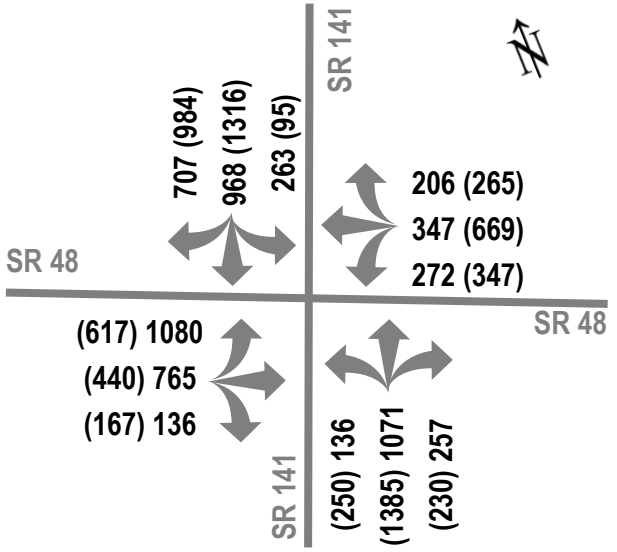


“Acceptable” Lane Configuration

“Acceptable” Conditions

Likely requires right-of-way acquisition

No further analysis for lane additions only recommended

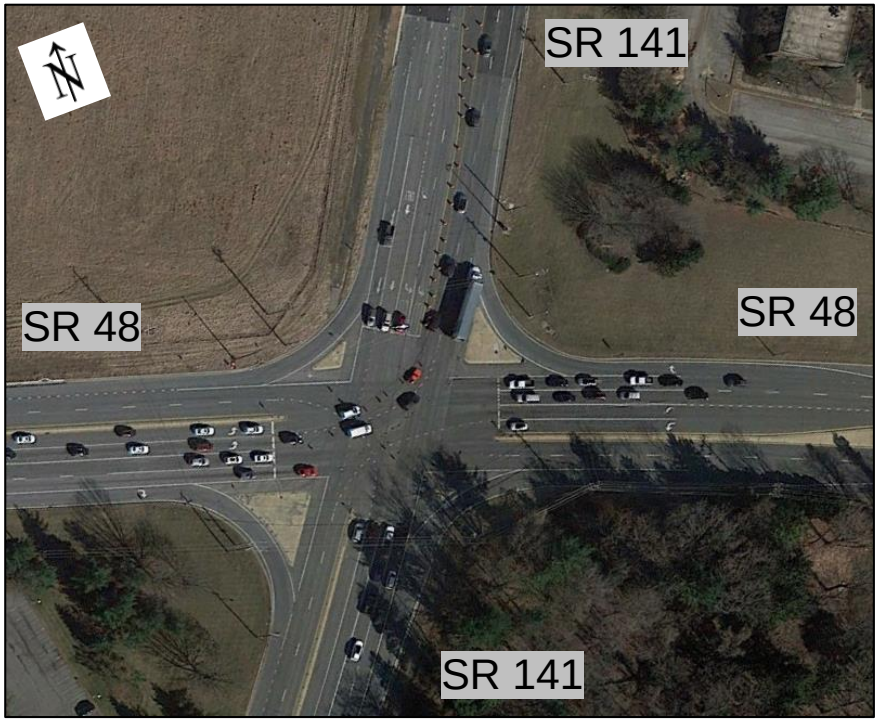


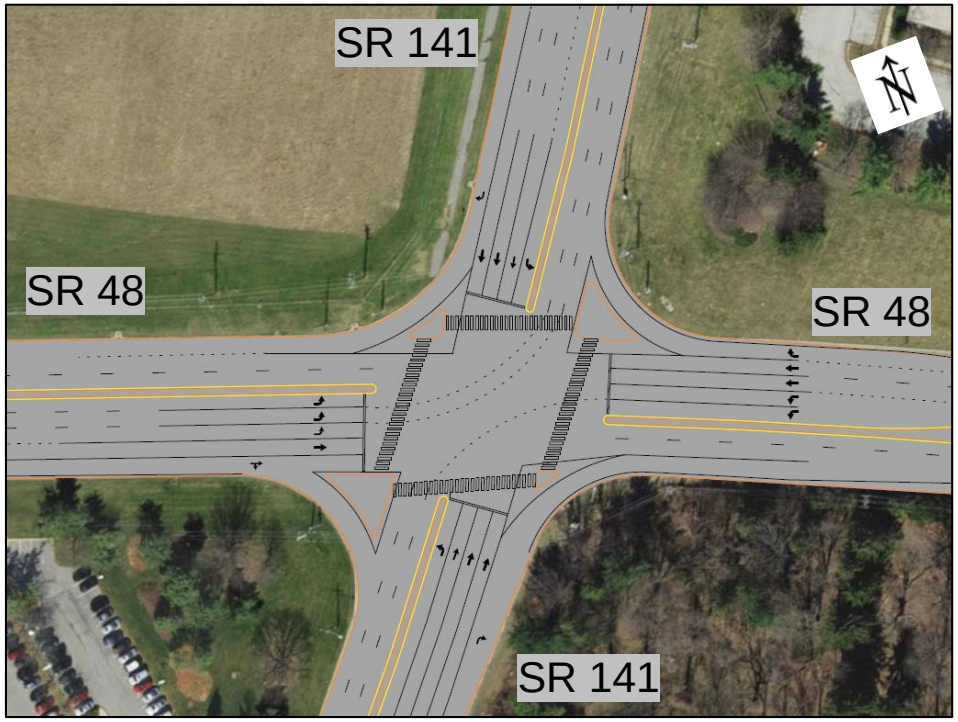
Peak Hour Turning Movement Volumes
Wednesday, May 17, 2017
AM (PM)

SR 141 at SR 48

Alternative 1: Reconstruct NB, SB, and EB approaches

- Utilizes existing right-of-way
- Restricted to lead/lag left turns on SR 48
- Reduces NB and SB L to a single lane
- Significant delay decreases in the NB and WB directions
- More leeway with signal timings
- Potential for EB T to block EB R with shared lane





SR 141 at SR 48

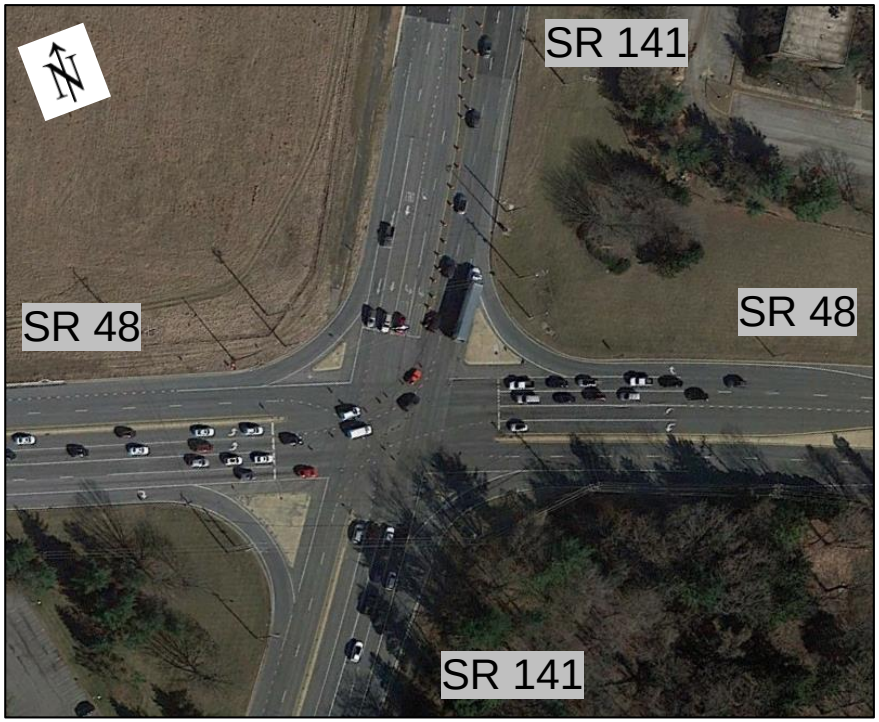
Alternative 1: Restripe NB, SB, and EB approaches

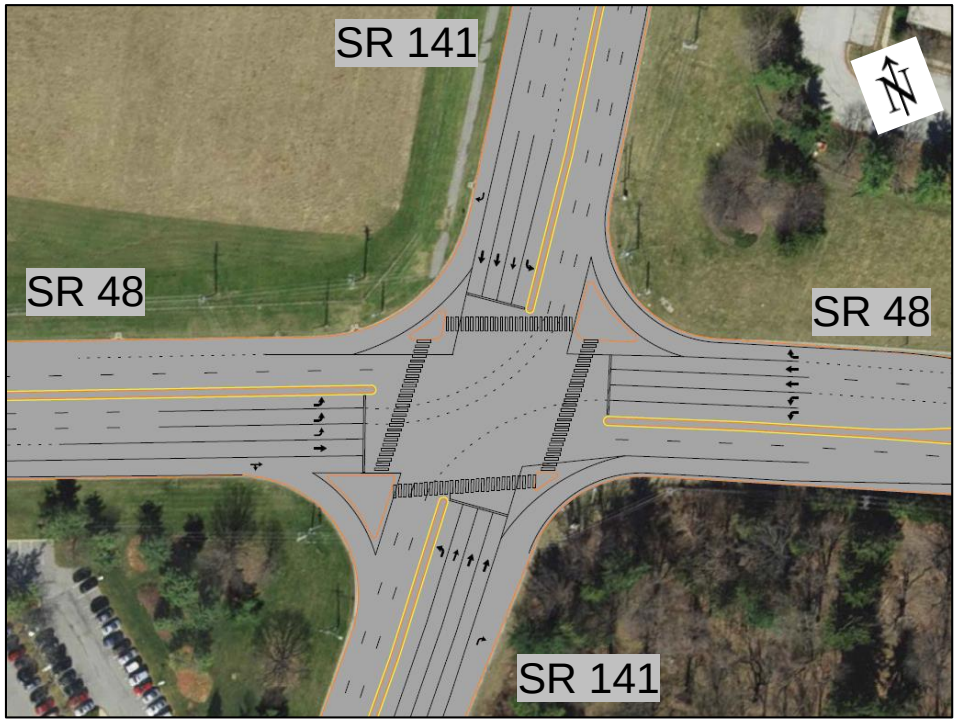
Existing Delay / Level of Service

	NB SR 141	SB SR 141	EB SR 48	WB SR 48	Intersection
AM	92.4 s / F	43.3 s / D	70.9 s / E	92.5 s / F	84.2 s / F
PM	75.7 s / E	120.7 s / F	94.8 s / F	94.4 s / F	98.6 s / F

Alternative 1 Delay / Level of Service

	NB SR 141	SB SR 141	EB SR 48	WB SR 48	Intersection
AM	57.9 s / E	49.5 s / D	66.2 s / E	66.4 s / E	59.5 s / E
PM	52.2 s / D	101.6 s / F	67.3 s / E	86.2 s / E	78.9 s / E





SR 141 at SR 48

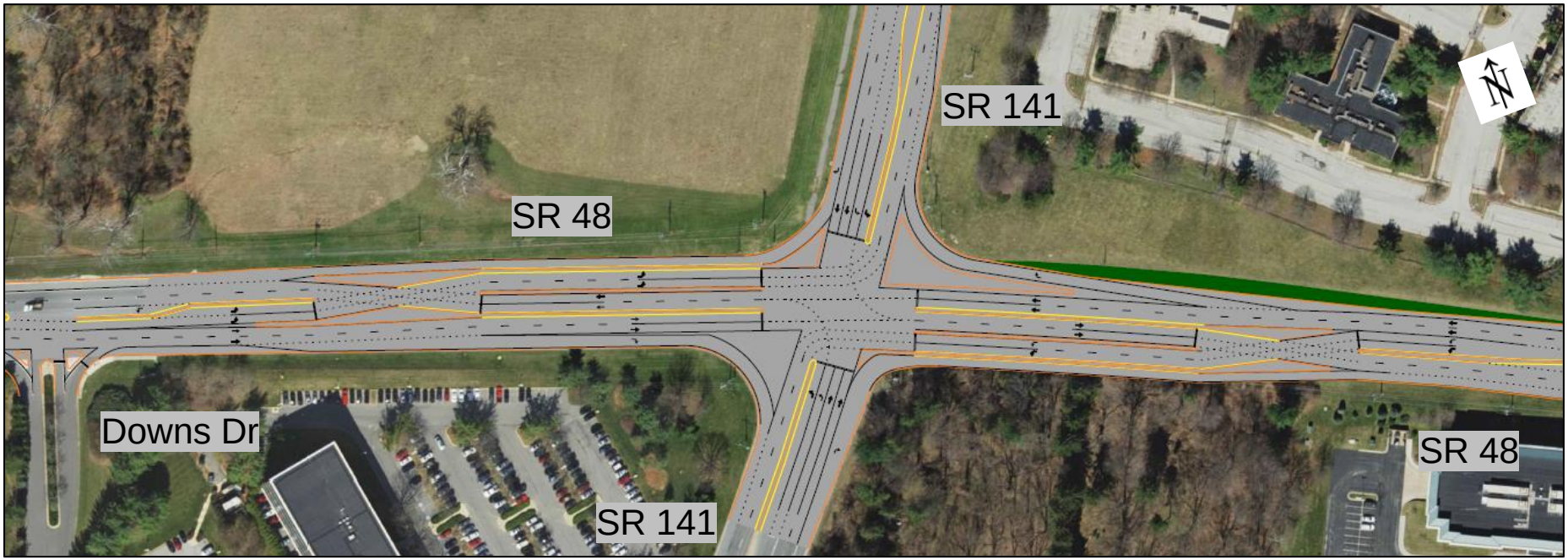
Alternative 2: Grade Separated Intersection

- Requires utilizing forested public right-of-way
- May have minor right-of-way impacts
- Elevates SR 141 over SR 48

SR 141 at SR 48

Alternative 3: Continuous Flow

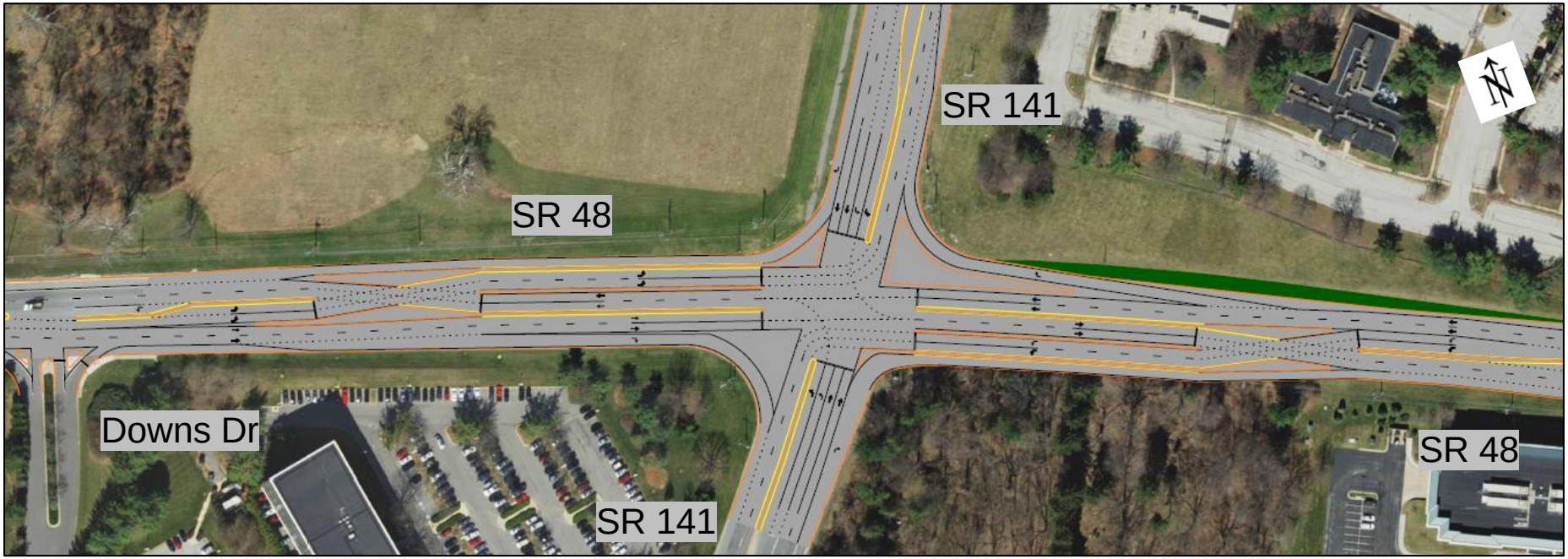
- Adds two new signalized intersections on SR 48
- Requires precise coordination of signals due to proximity
- Reduces number of phases and conflicts
- NB R and SB R converted to “slip lanes”
- Requires widening
- Potential impacts to Downs Drive



SR 141 at SR 48

Alternative 3: Continuous Flow

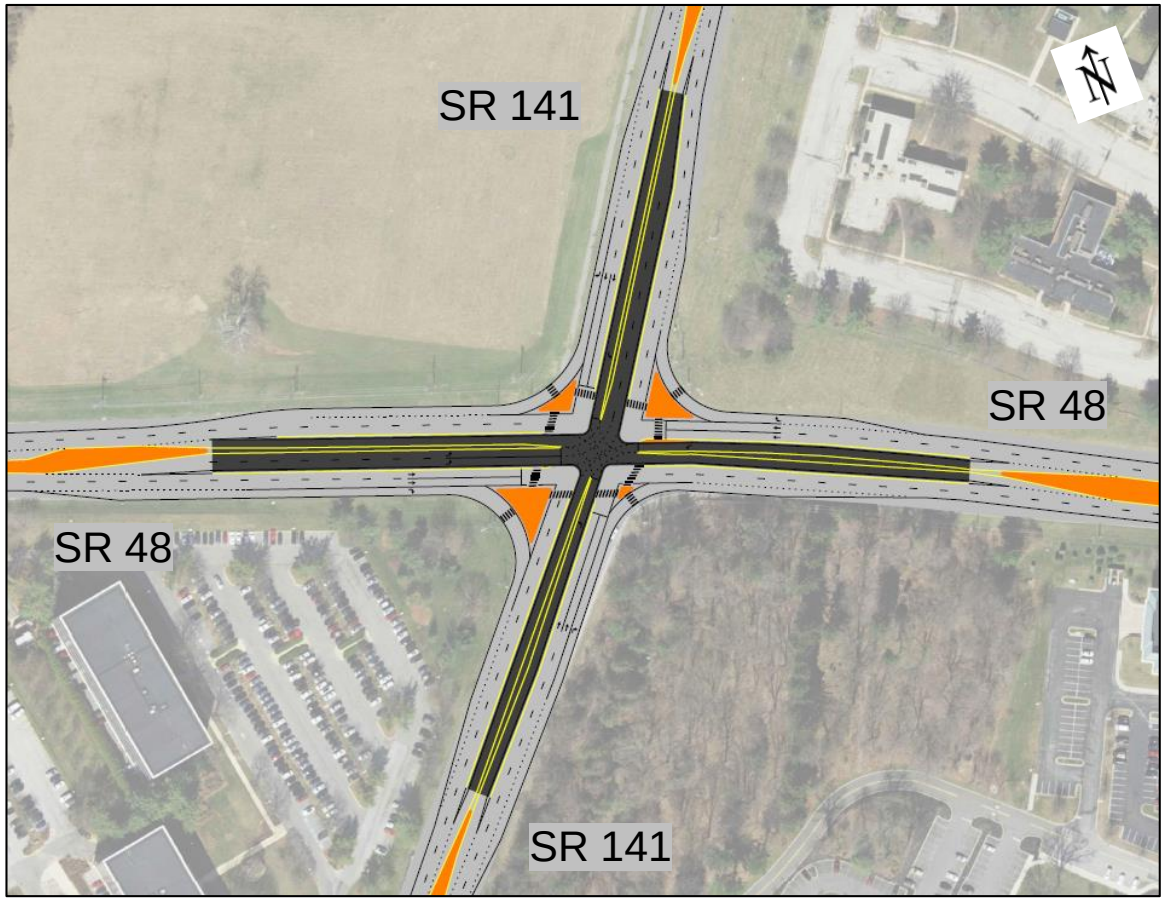
Delay / LOS		SR 141 NB	SR 141 SB	SR 48 EB	SR 48 WB	SR 48 EB L	SR 48 WB L	SR 141 NB L	SR 141 SB L	Intersection
Existing	AM	94.9 s / F	57.2 s / E	71.6 s / E	96.5 s / F	90.6 s / F	72.3 s / E	75.9 s / E	110.2 s / F	84.2 s / F
	PM	77.4 s / E	182.0 s / F	96.8 s / F	96.7 s / F	139.3 s / F	69.6 s / E	72.2 s / E	74.0 s / E	98.6 s / F
Alt 3	AM	37.8 s / D	33.3 s / C	52.8 s / D	41.8 s / D	48.7 s / D	69.0 s / E	68.8 s / E	69.0 s / E	39.6 s / D
	PM	34.4 s / C	37.5 s / D	47.6 s / D	54.8 s / D	66.6 s / E	67.8 s / E	69.1 s / E	68.9 s / E	40.3 s / D



SR 141 at SR 48

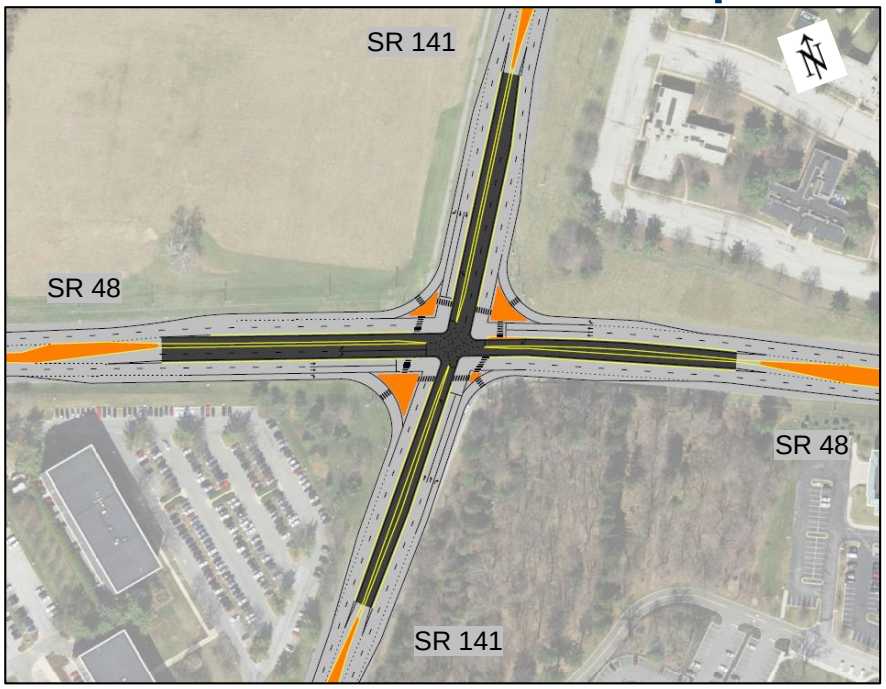
Alternative 4: Center Turn Overpass (“Elevated Lefts”)

- Adds a signalized overpass for all left turns
- Maintains EB double left
- Reduces number of phases and conflicts
- Provides the ability to shorten cycle lengths
- Likely requires no additional right-of-way acquisition



SR 141 at SR 48

Alternative 4: Center Turn Overpass



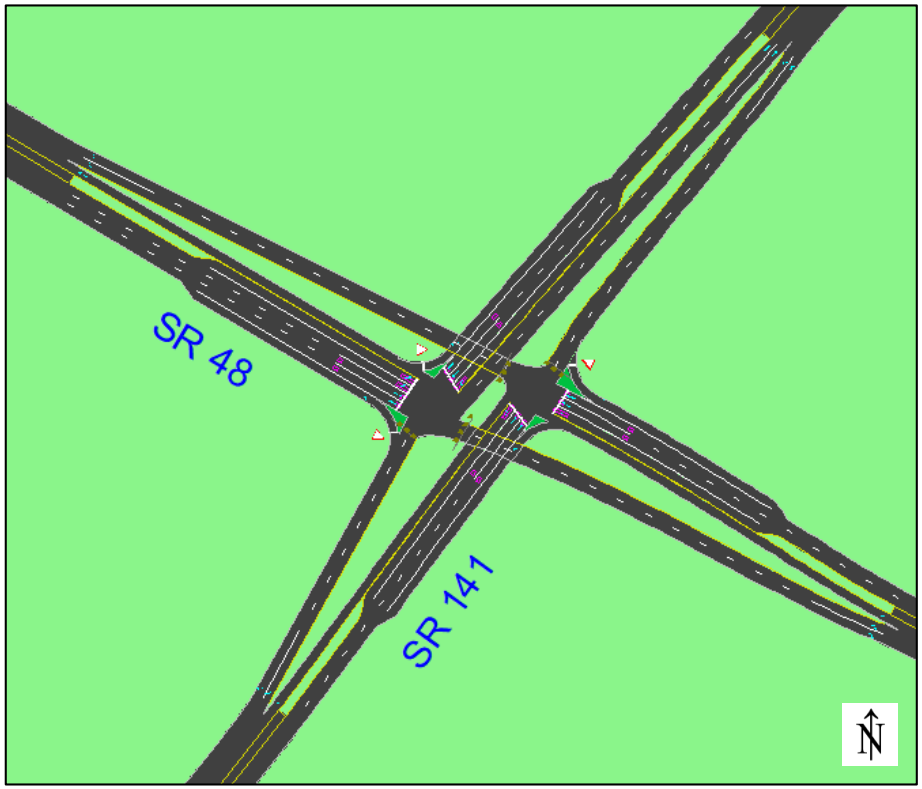
Delay / LOS		SR 141 NB	SR 141 SB	SR 48 EB	SR 48 WB	SR 48 EB L	SR 48 WB L	SR 141 NB L	SR 141 SB L	Intersection
Existing	AM	94.9 s / F	57.2 s / E	71.6 s / E	96.5 s / F	90.6 s / F	72.3 s / E	75.9 s / E	110.2 s / F	84.2 s / F
	PM	77.4 s / E	182.0 s / F	96.8 s / F	96.7 s / F	139.3 s / F	69.6 s / E	72.2 s / E	74.0 s / E	98.6 s / F
Alt 4	AM	13.1 s / B	16.6 s / B	30.2 s / C	22.2 s / C	20.3 s / C	14.4 s / B	15.5 s / B	17.9 s / B	19.2 s / B 18.7 s / B*
	PM	11.6 s / B	44.3 s / D	26.6 s / C	39.0 s / C	25.1 s / C	29.2 s / C	9.8 s / A	8.4 s / A	32.1 s / C 22.0 s / C*

*Elevated Lefts Intersection

SR 141 at SR 48

Alternative 5: Echelon

- Splits existing SR 141 at SR 48 intersection into two signalized intersections
- Maintains existing lane configuration
- Provides the ability to shorten cycle lengths
- Reduces number of conflicts at each intersection
- Likely requires additional right-of-way



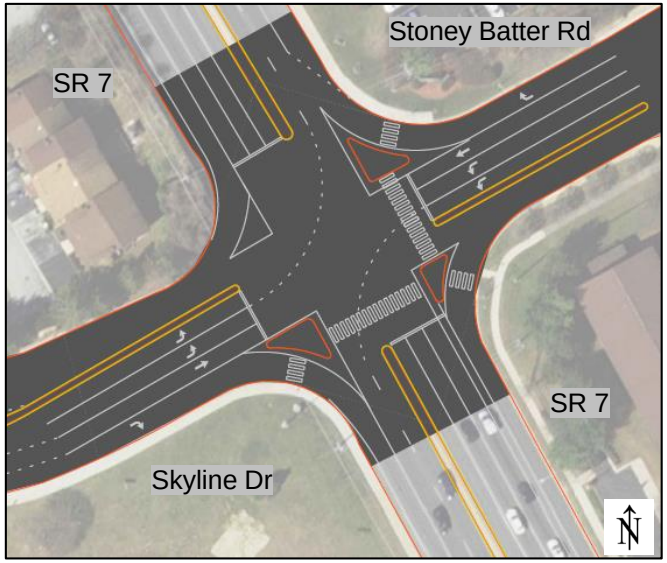
Delay / LOS		SR 141 NB	SR 141 SB	SR 48 EB	SR 48 WB	SR 48 EB L	SR 48 WB L	SR 141 NB L	SR 141 SB L	Intersection
Existing	AM	94.9 s / F	57.2 s / E	71.6 s / E	96.5 s / F	90.6 s / F	72.3 s / E	75.9 s / E	110.2 s / F	84.2 s / F
	PM	77.4 s / E	182.0 s / F	96.8 s / F	96.7 s / F	139.3 s / F	69.6 s / E	72.2 s / E	74.0 s / E	98.6 s / F
Alt 5	AM	10.0 s / B	18.7 s / B	21.0 s / C	25.1 s / C	24.2 s / C	27.9 s / C	7.5 s / A	16.0 s / B	19.8 s / B 15.5 s / B
	PM	14.7 s / B	12.8 s / B	28.3 s / C	26.2 s / C	31.6 s / C	28.8 s / C	9.8 s / A	6.8 s / A	18.1 s / B 19.4 s / B

Recommendation #15

Next Steps for Formal Design Assessments

SR 7 at Skyline Drive

Short Term: Alternative 1B – Reconstruct EB and WB approaches with concurrent side-street phasing



SR 2 at SR 7

Long Term: Alternative 4 – Center Turn Overpass ("Elevated Lefts")

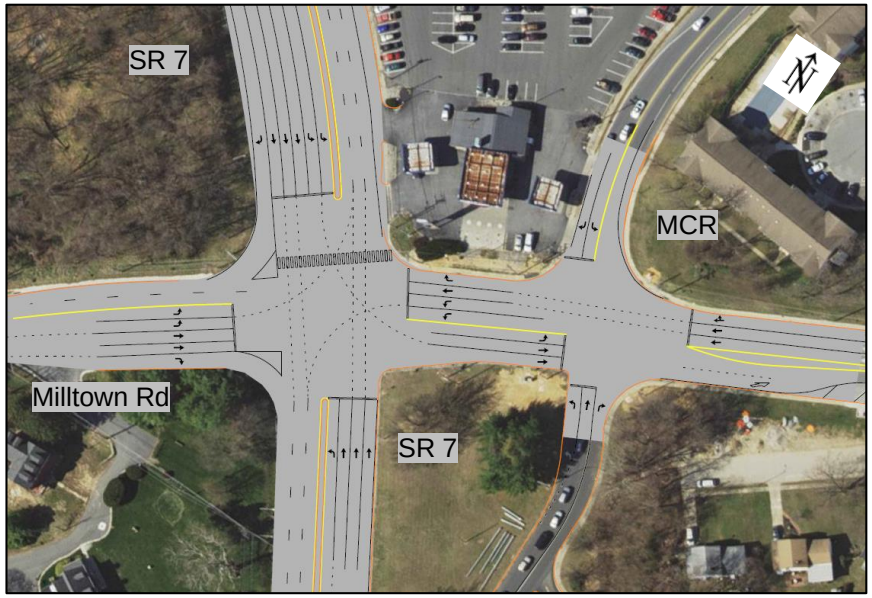
Recommendation #15

Next Steps for Formal Design Assessments

SR 7 at Milltown Road

Short Term: Alternative 1C – Restripe SR 7

Long Term: Alternative 4 – SR 7 Thru Overpass



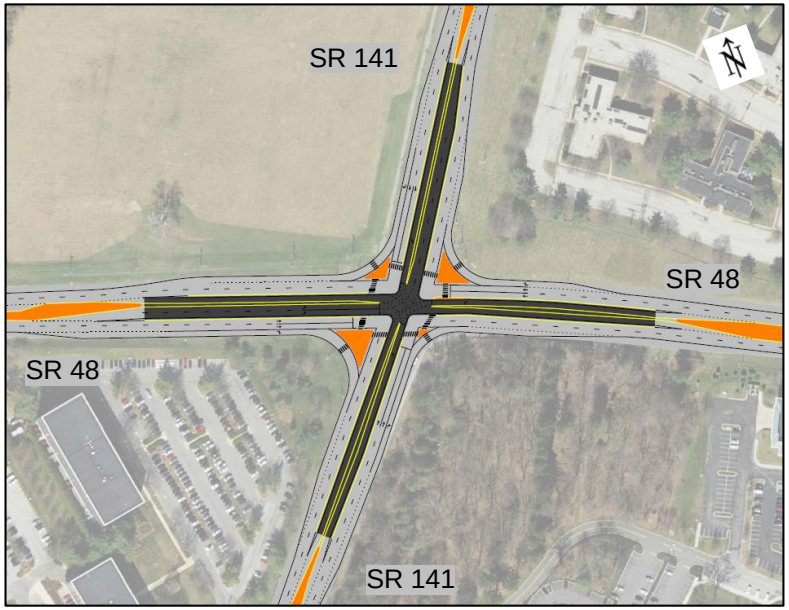
SR 41 at Milltown Road

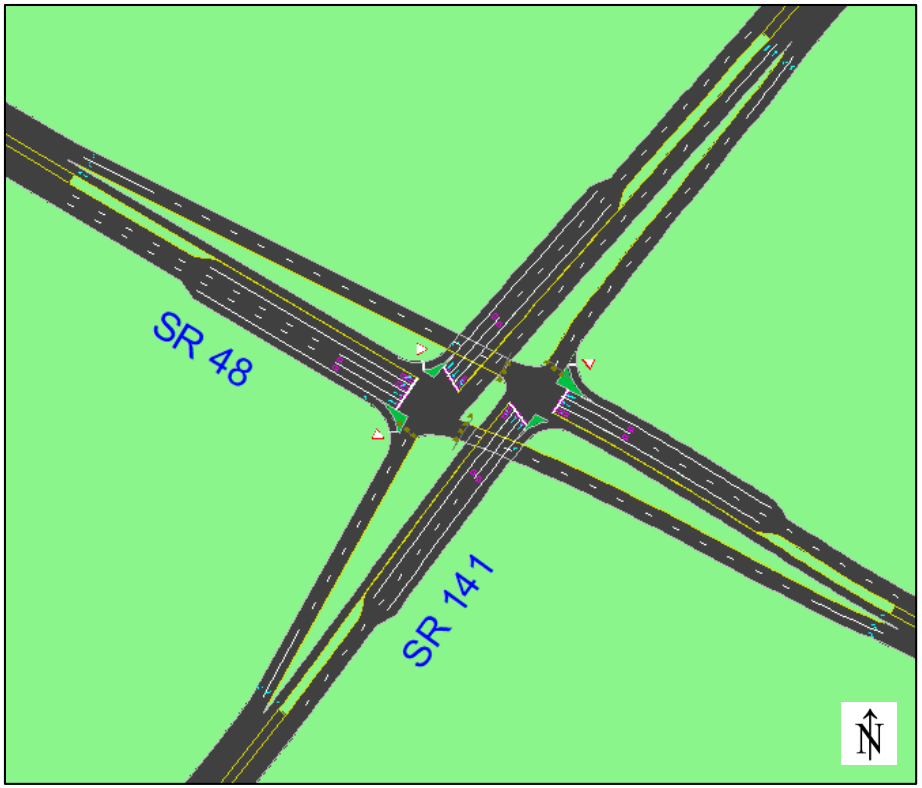
No geometric improvements

SR 141 at SR 48

Long Term:

Alternative 4 – Center Turn Overpass (“Elevated Lefts”) or
Alternative 5 – Echelon





Recommendation #15

Next Steps for Formal Design Assessments

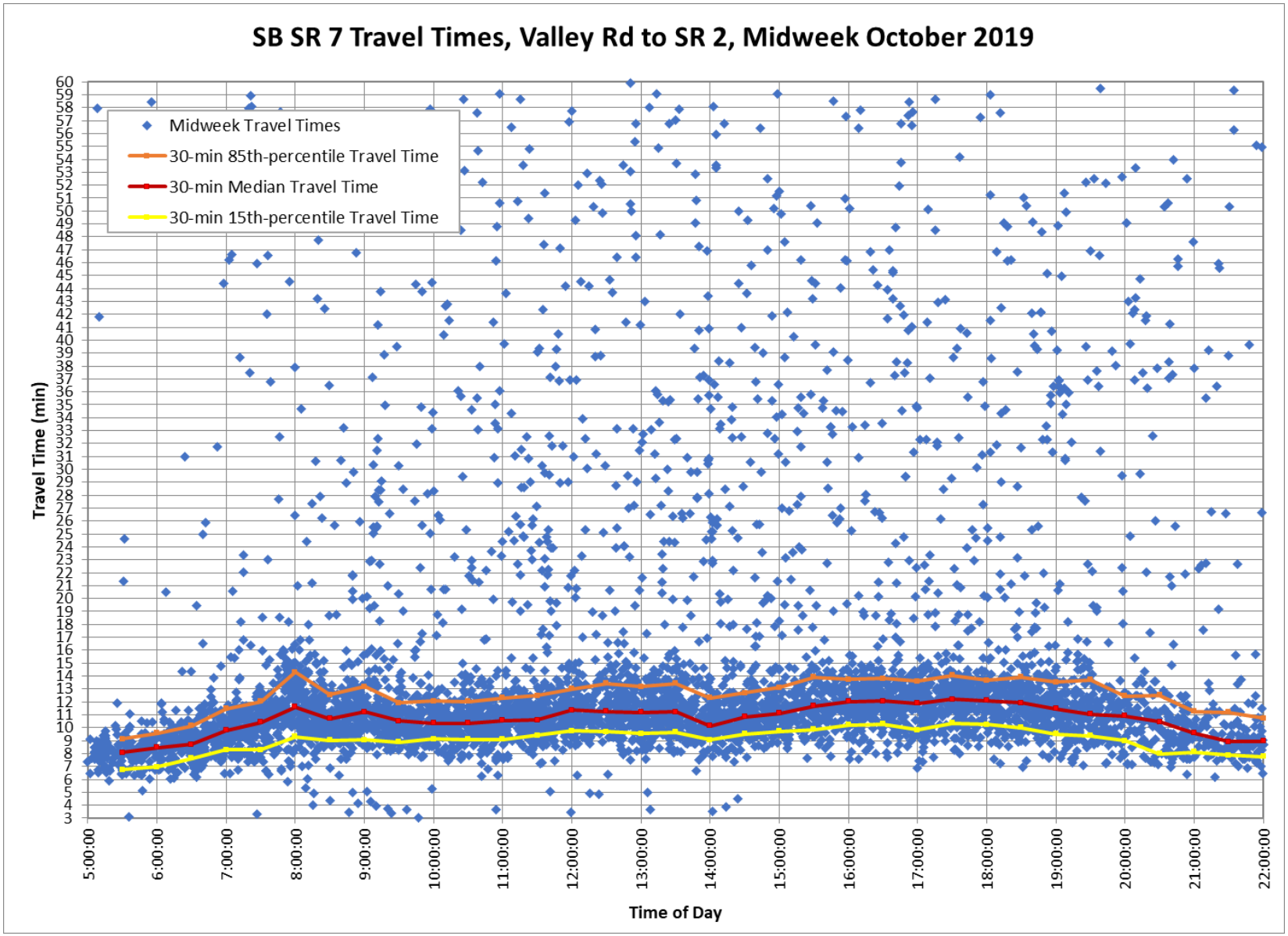
Next Steps

- Short-Term Recommendations
  - Analyze traffic growth and forecasting
  - Begin final design efforts, including minor signal improvements to correspond with striping/phasing
  - Prioritize into appropriate DelDOT program
- Long-Term Recommendations
  - Consider additional alternatives/configurations as part of future project development and public involvement
  - Continue to target congestion-related crash history in conjunction with Road Safety Audit recommendations
  - Develop programming level cost estimates
  - Coordinate with WILMAPCO to consider projects to be added to the Long Range Plan and future Transportation Improvement Program (TIP) and Capital Transportation Program (CTP)

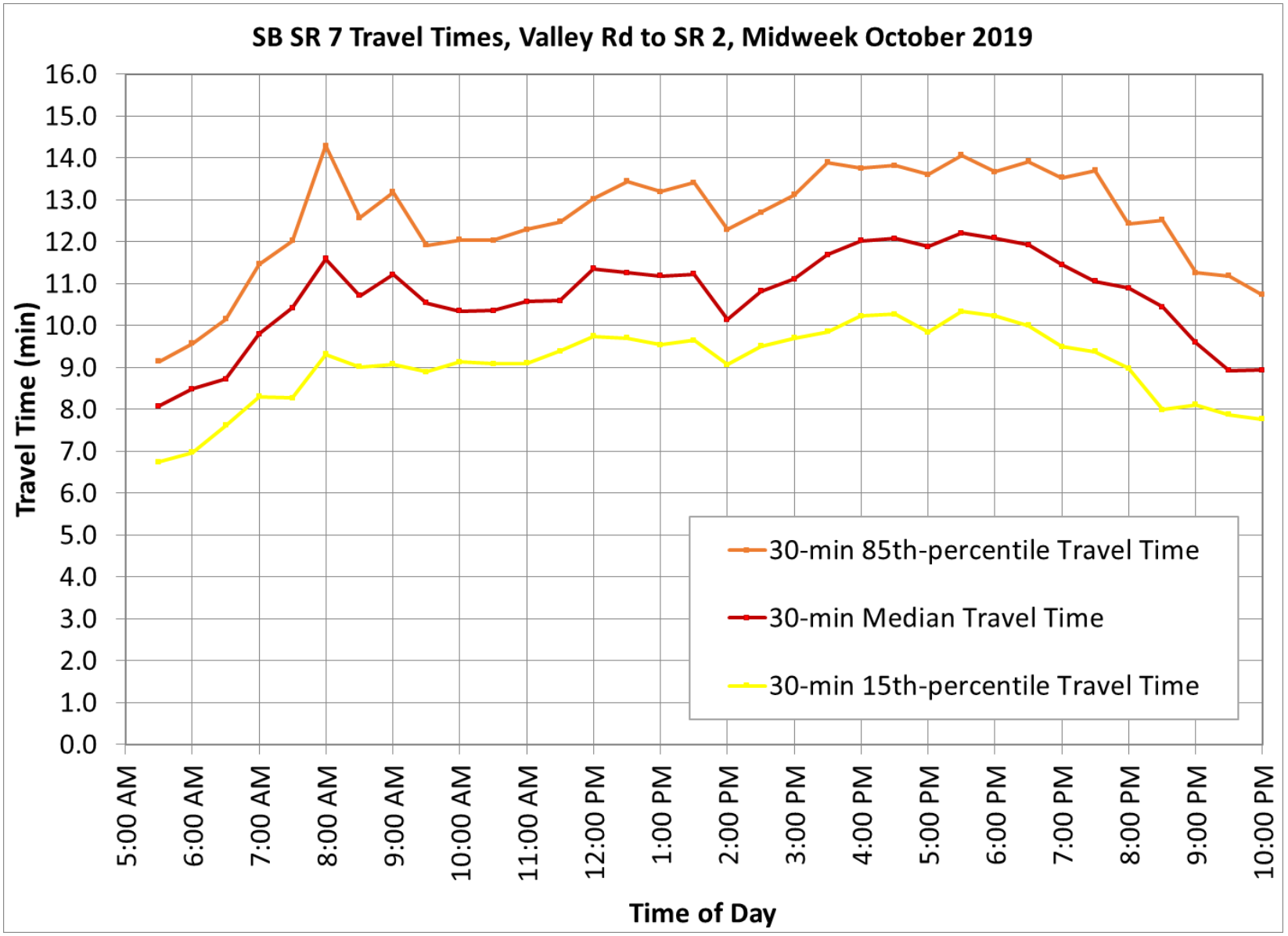
THANK YOU!

APPENDIX A – TRAVEL TIME DATA

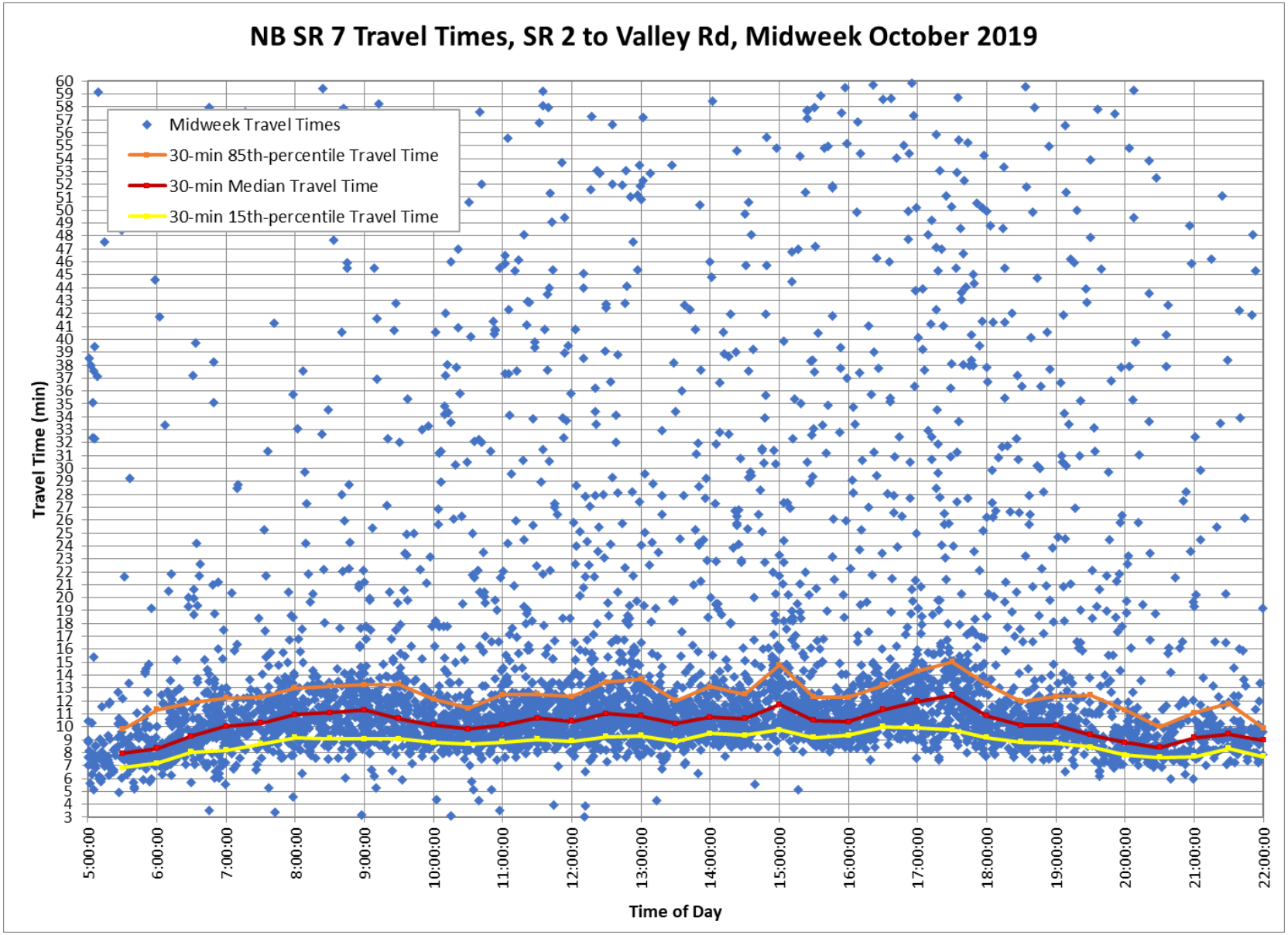
SR 7 Travel Times
Bluetooth Data



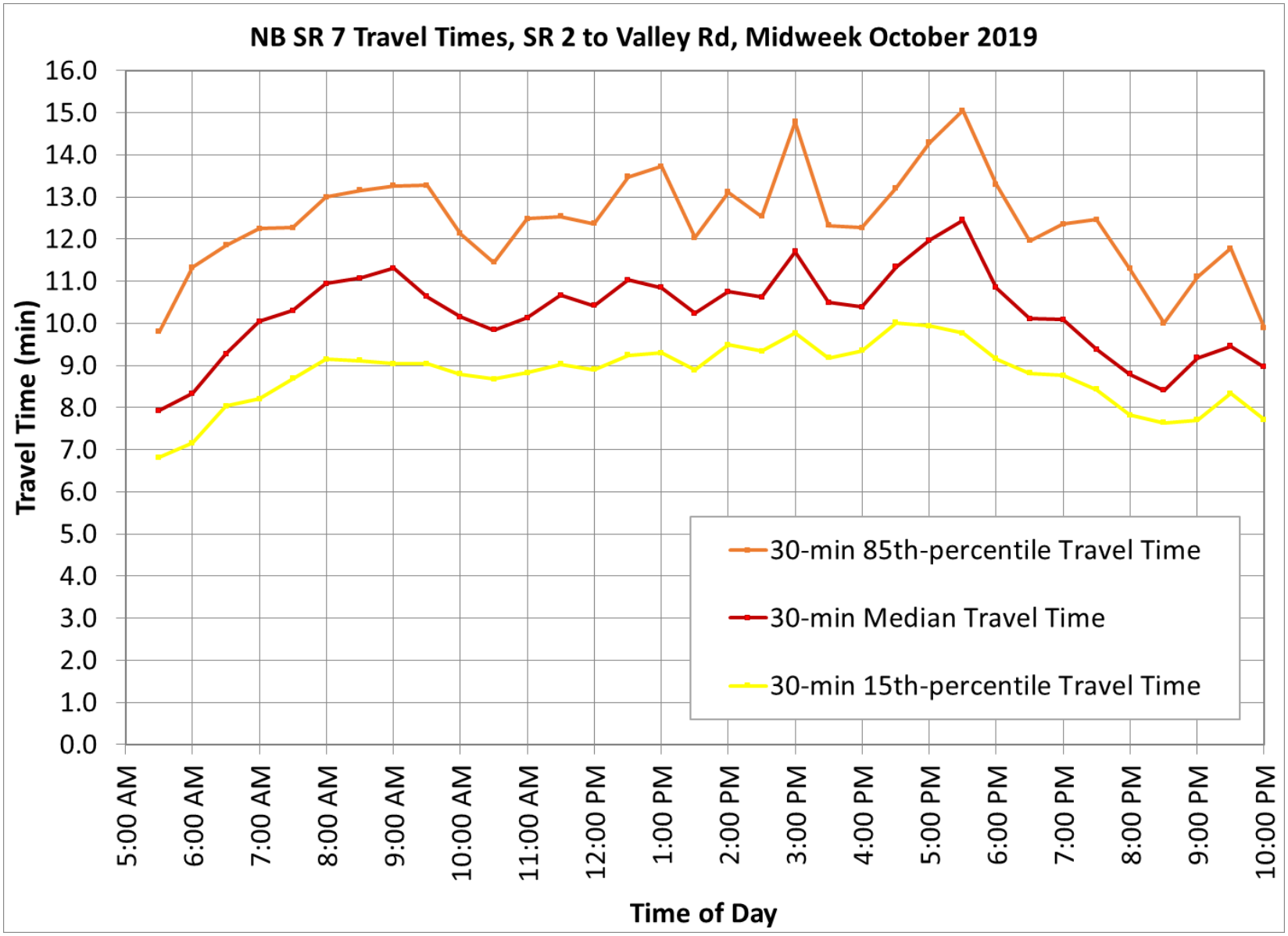
SR 7 Travel Times
Bluetooth Data



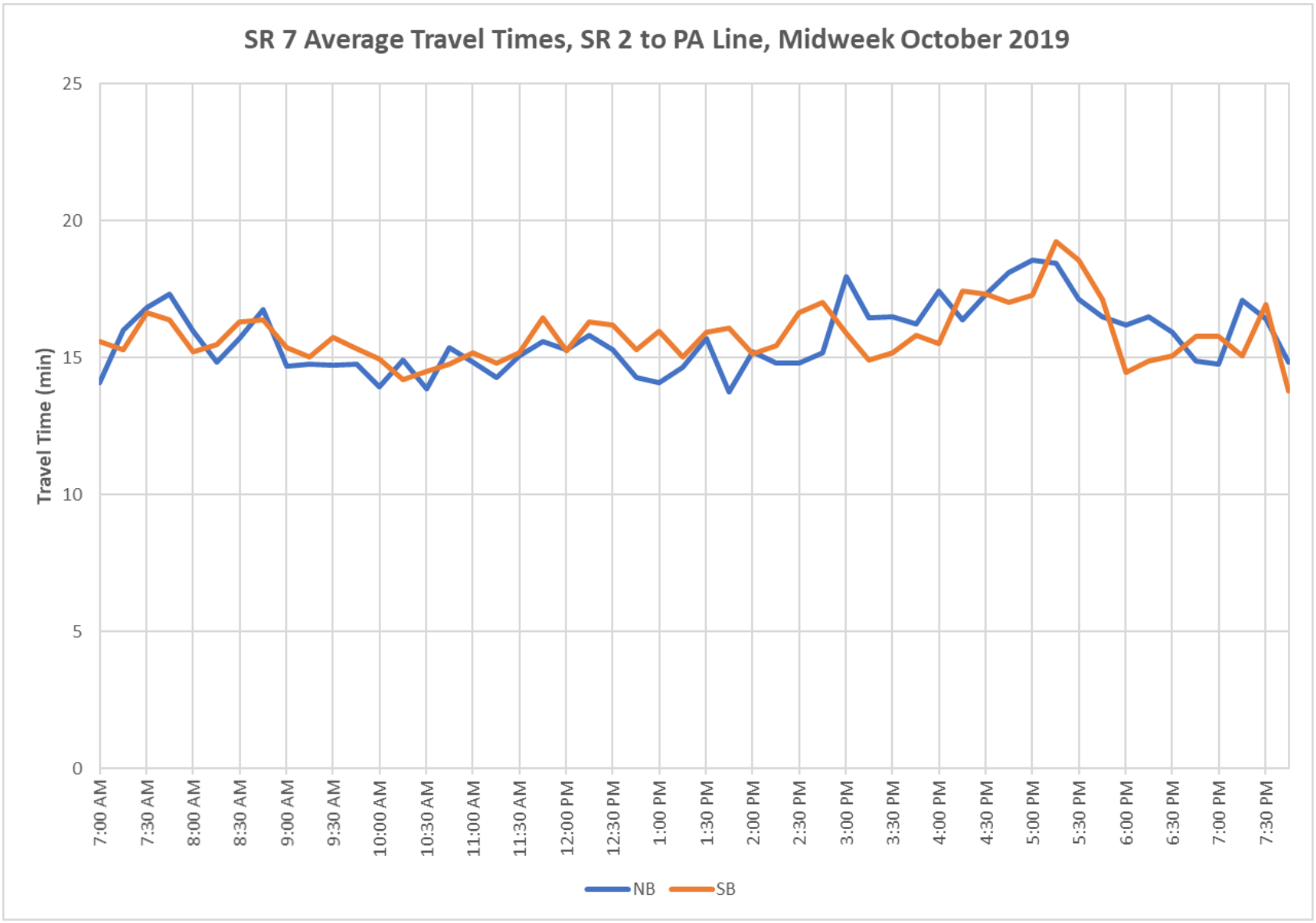
SR 7 Travel Times
Bluetooth Data



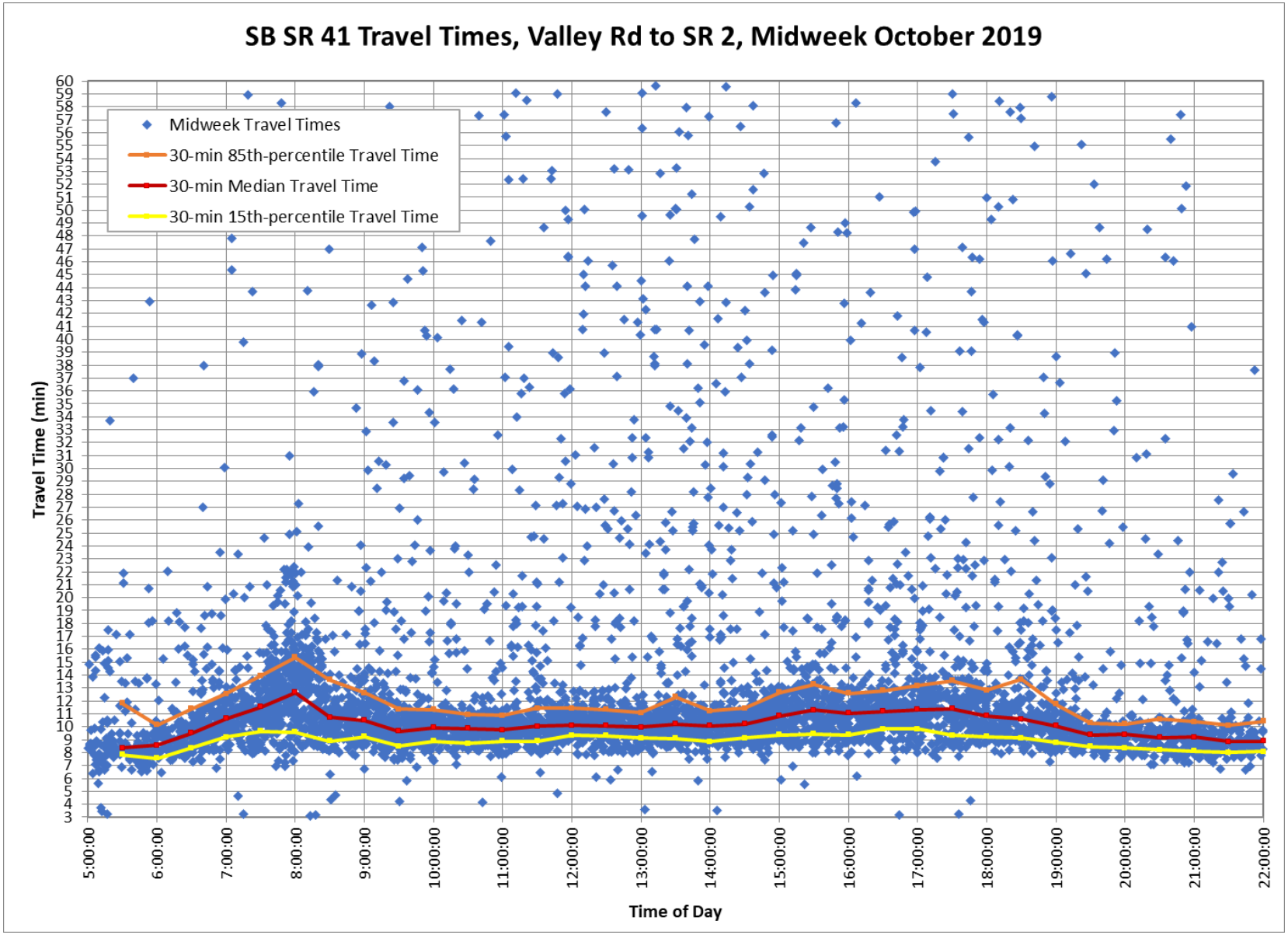
SR 7 Travel Times
Bluetooth Data



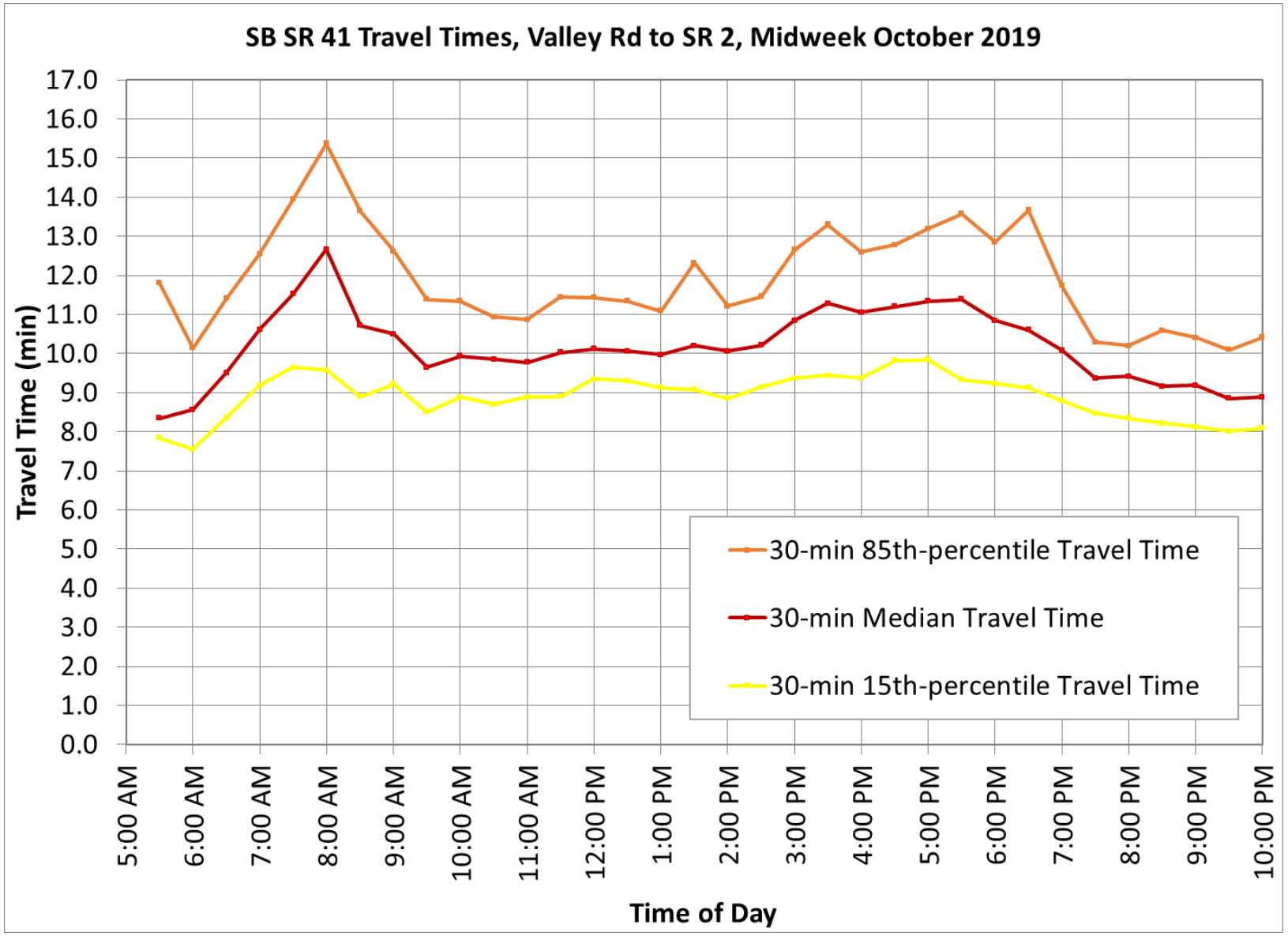
SR 7 Travel Times
RITIS Data



SR 41 Travel Times
Bluetooth Data



SR 41 Travel Times
Bluetooth Data



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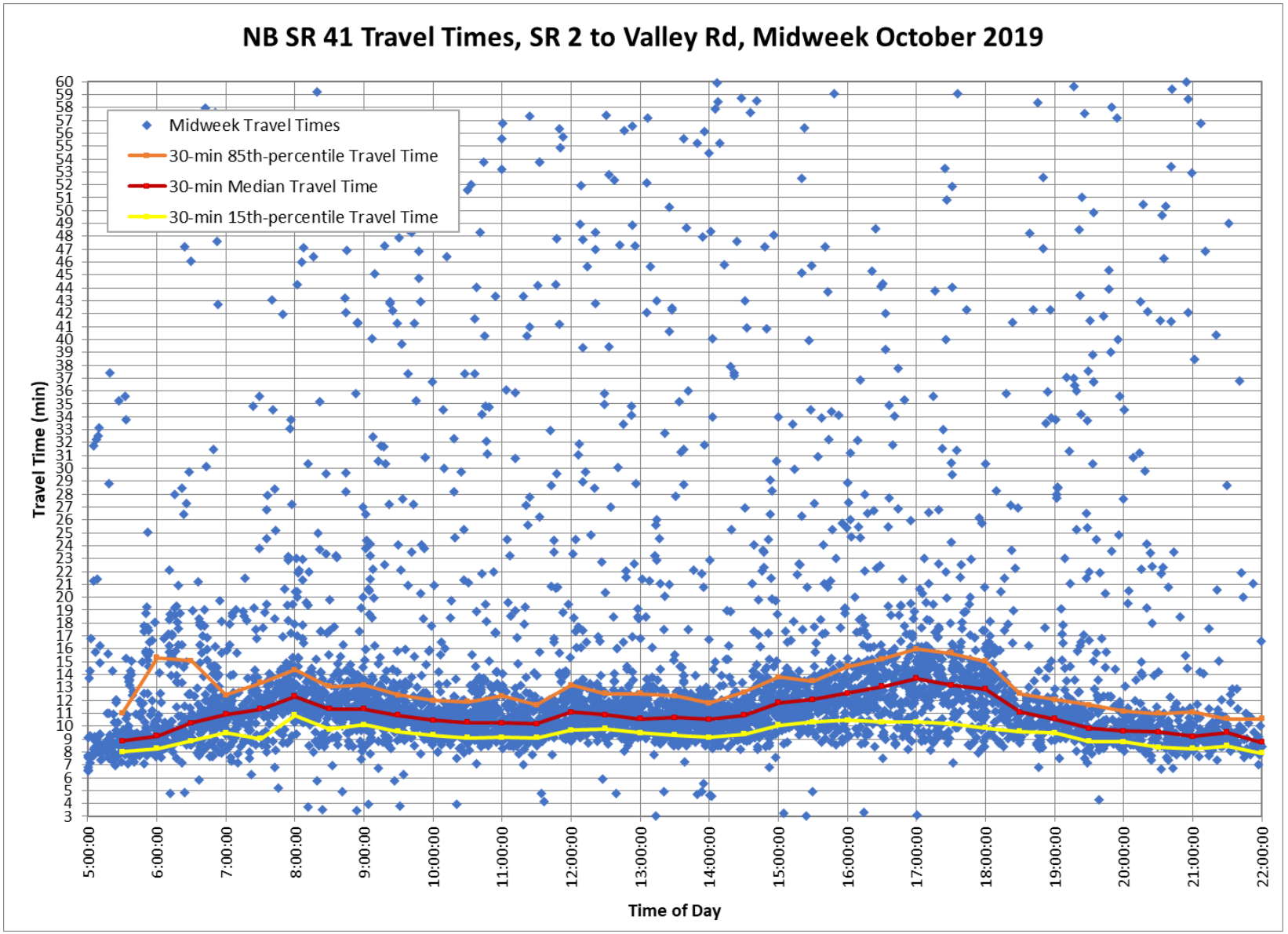
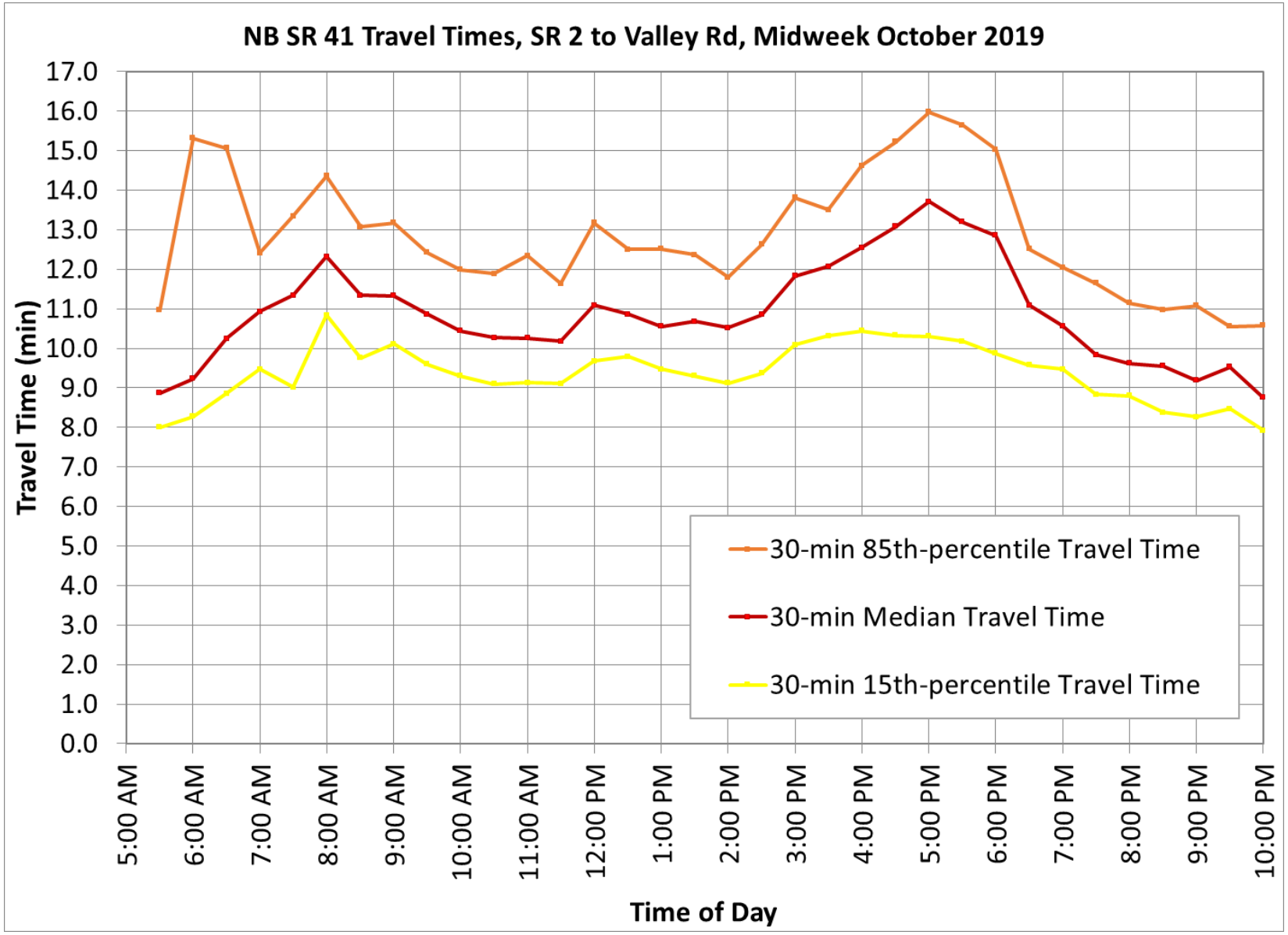
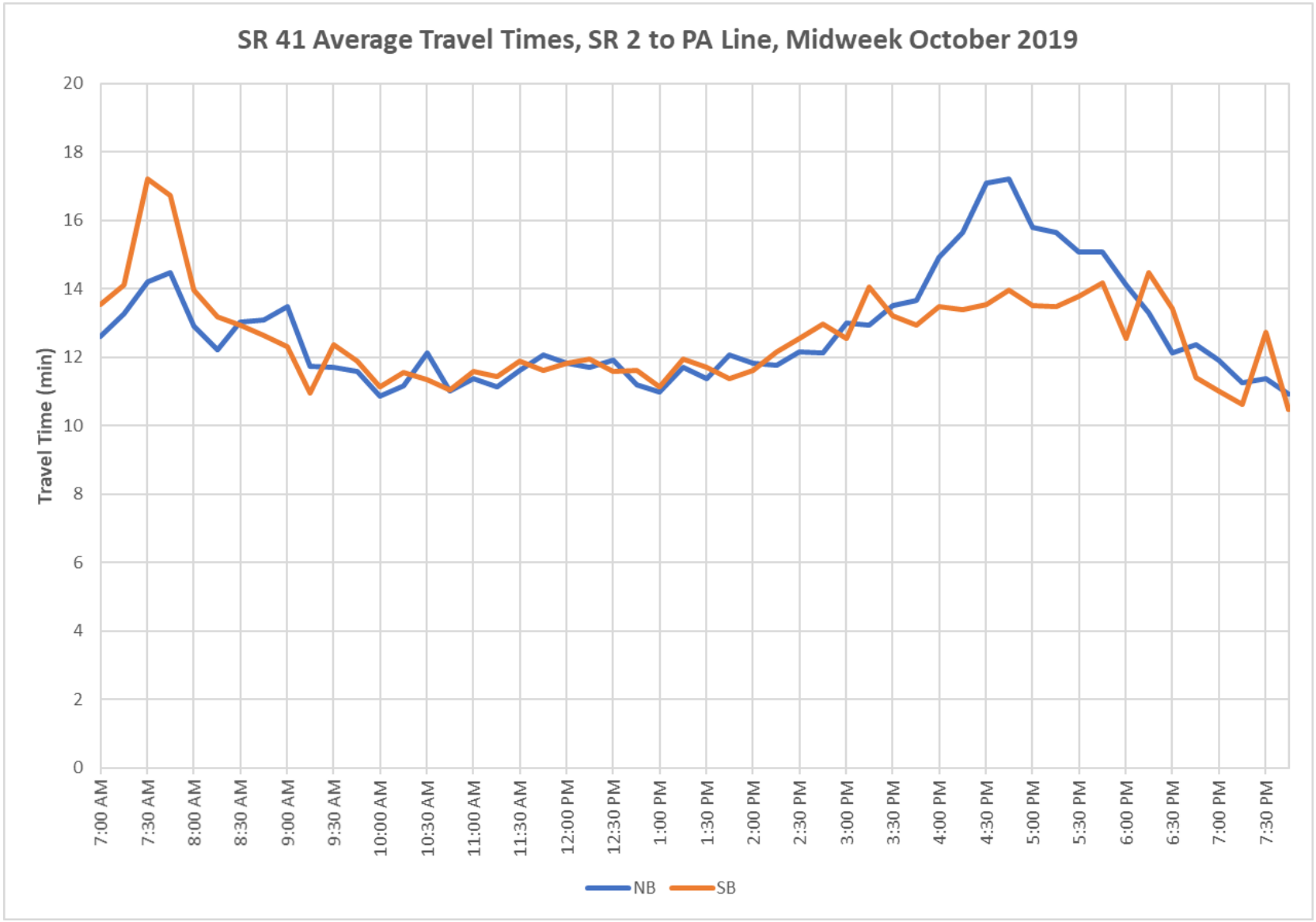
Bluetooth Data



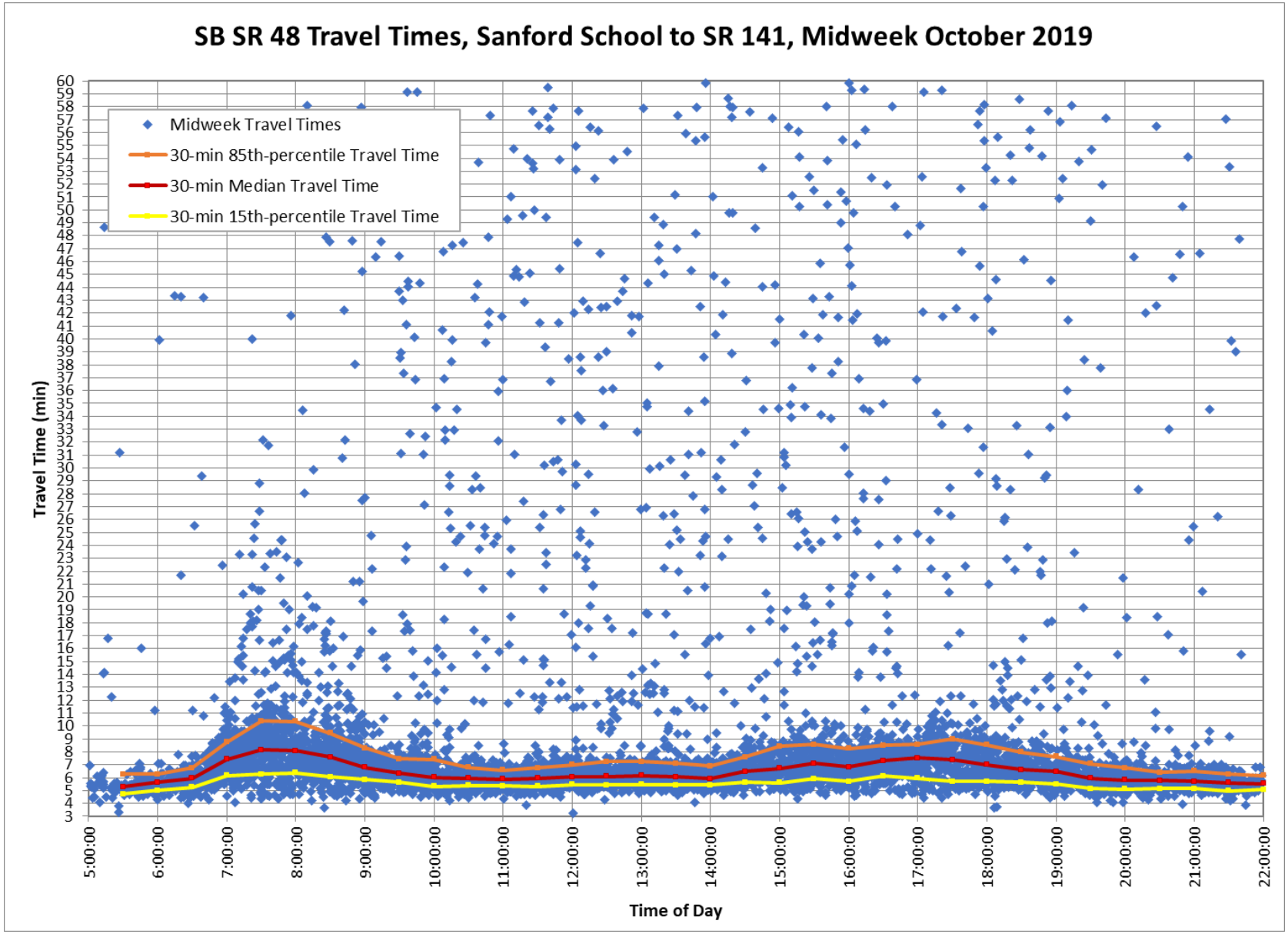
SR 41 Travel Times
Bluetooth Data



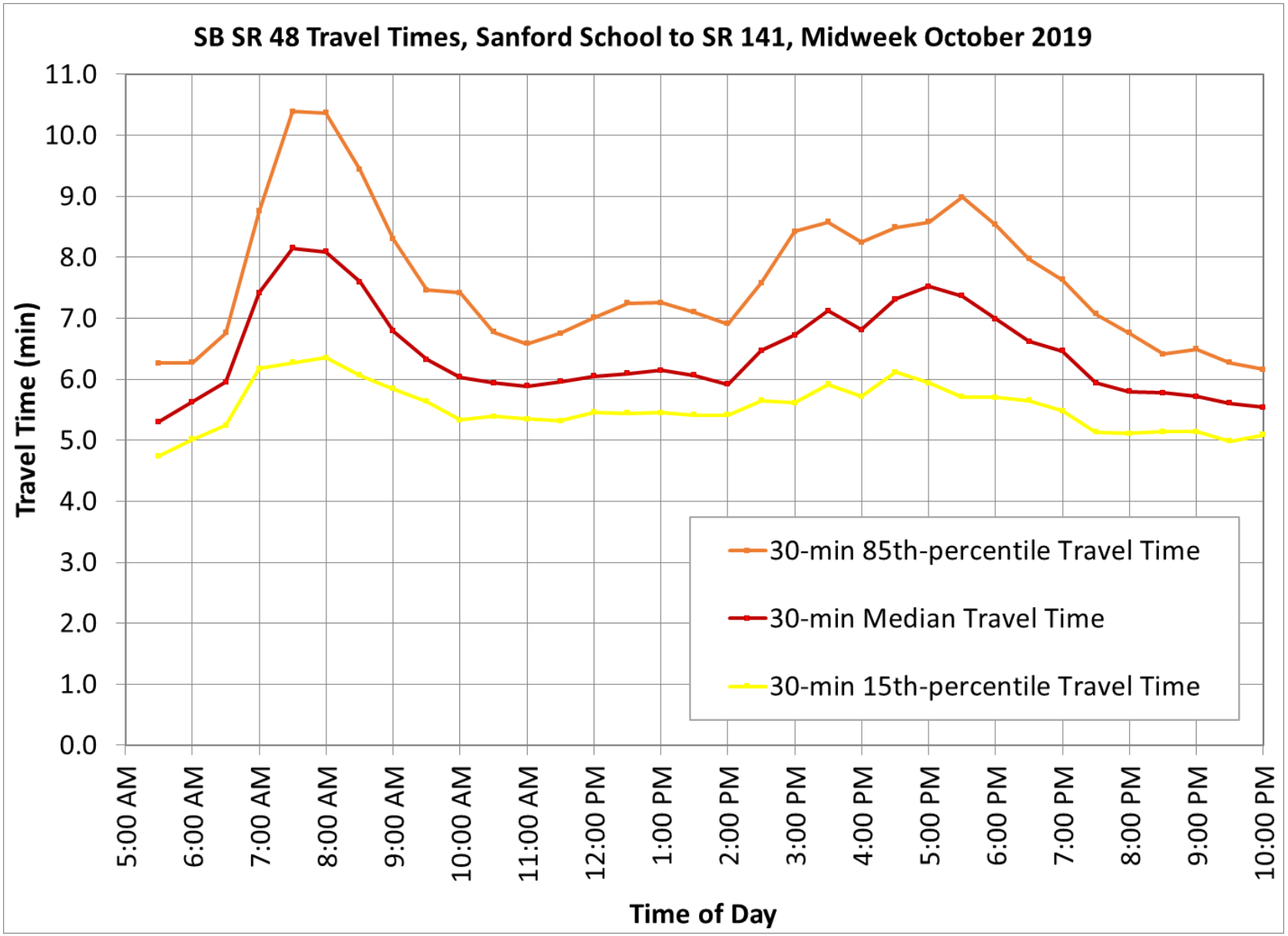
SR 41 Travel Times
RITIS Data



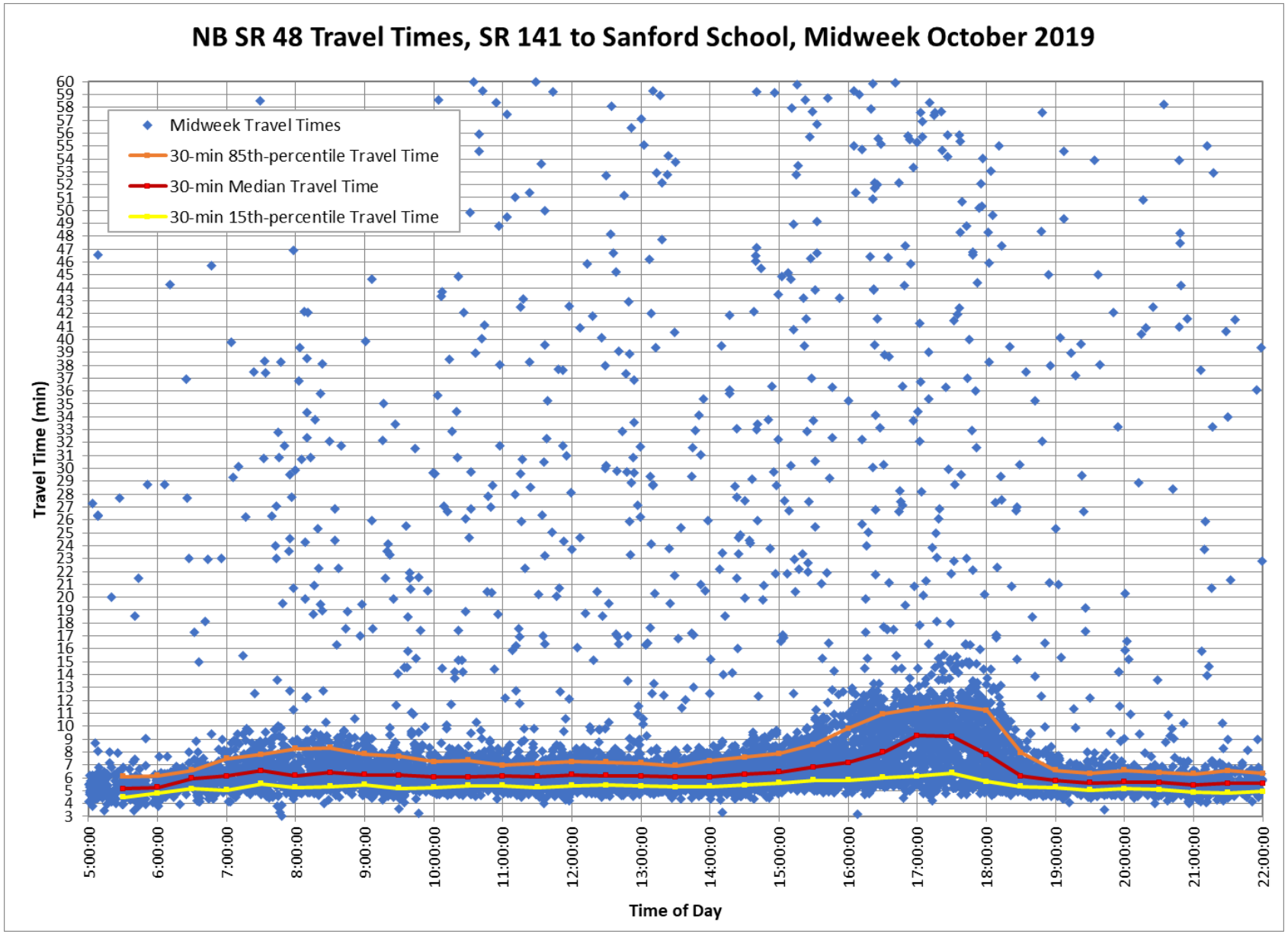
SR 48 Travel Times
Bluetooth Data



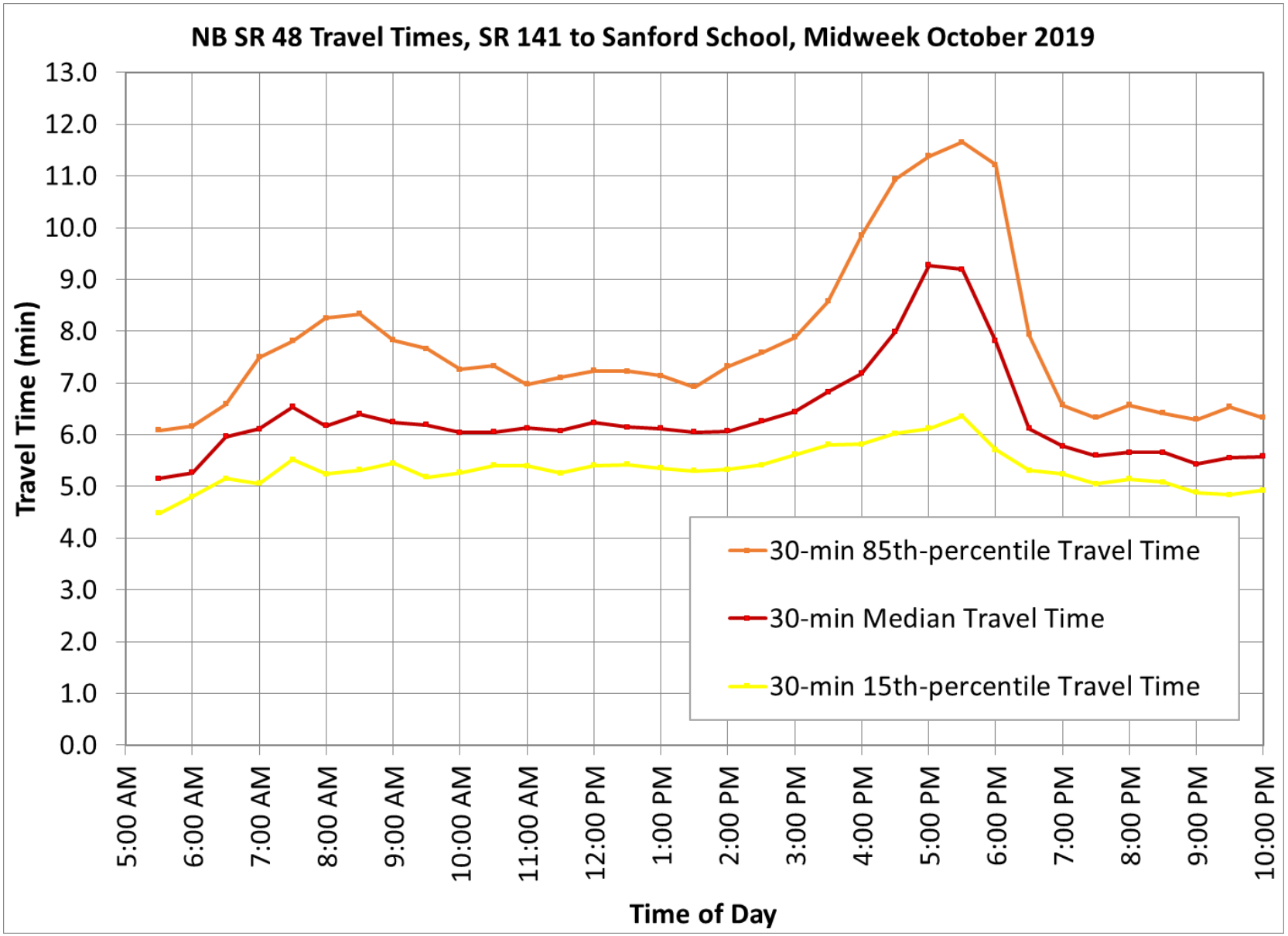
SR 48 Travel Times
Bluetooth Data



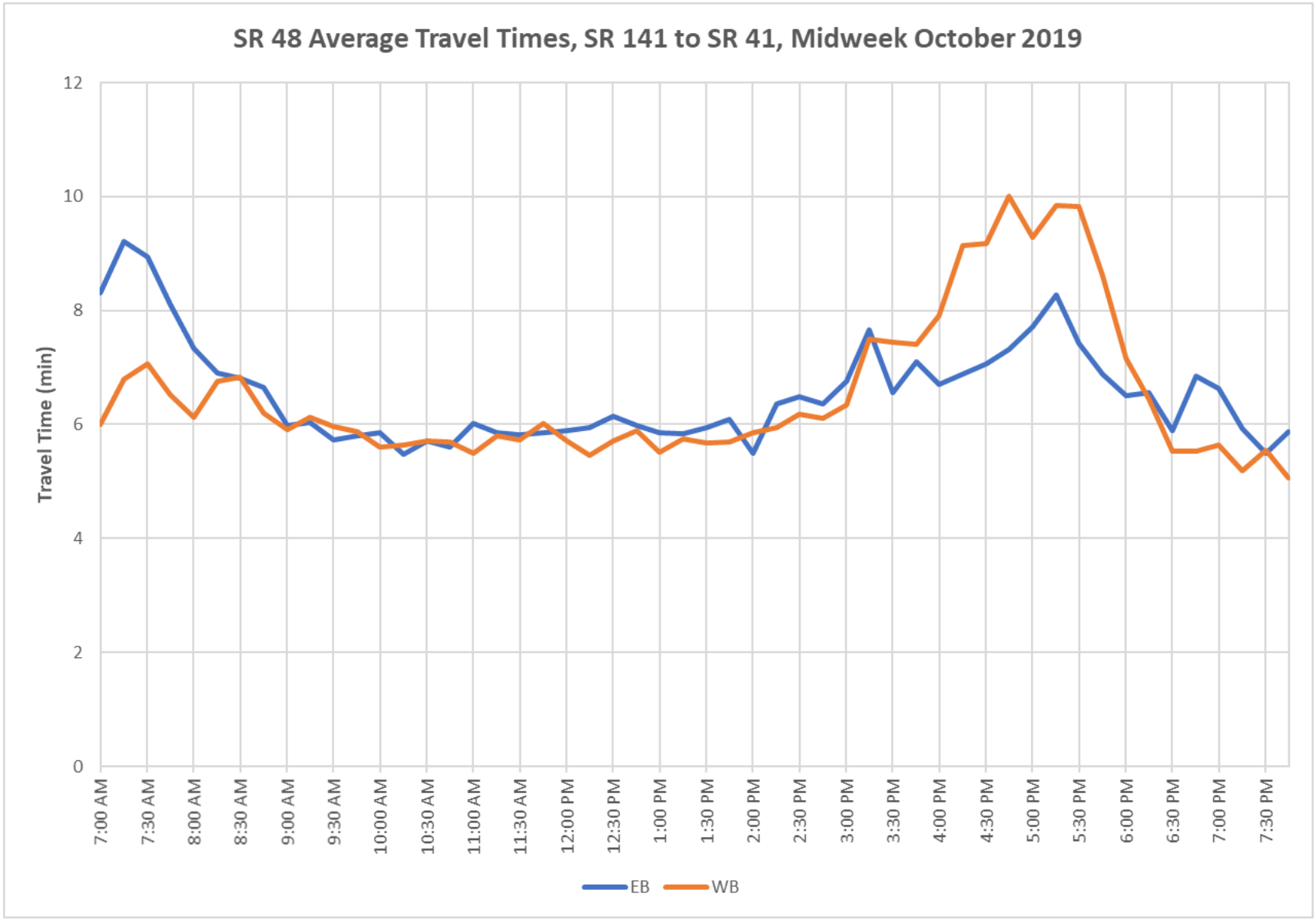
SR 48 Travel Times
Bluetooth Data



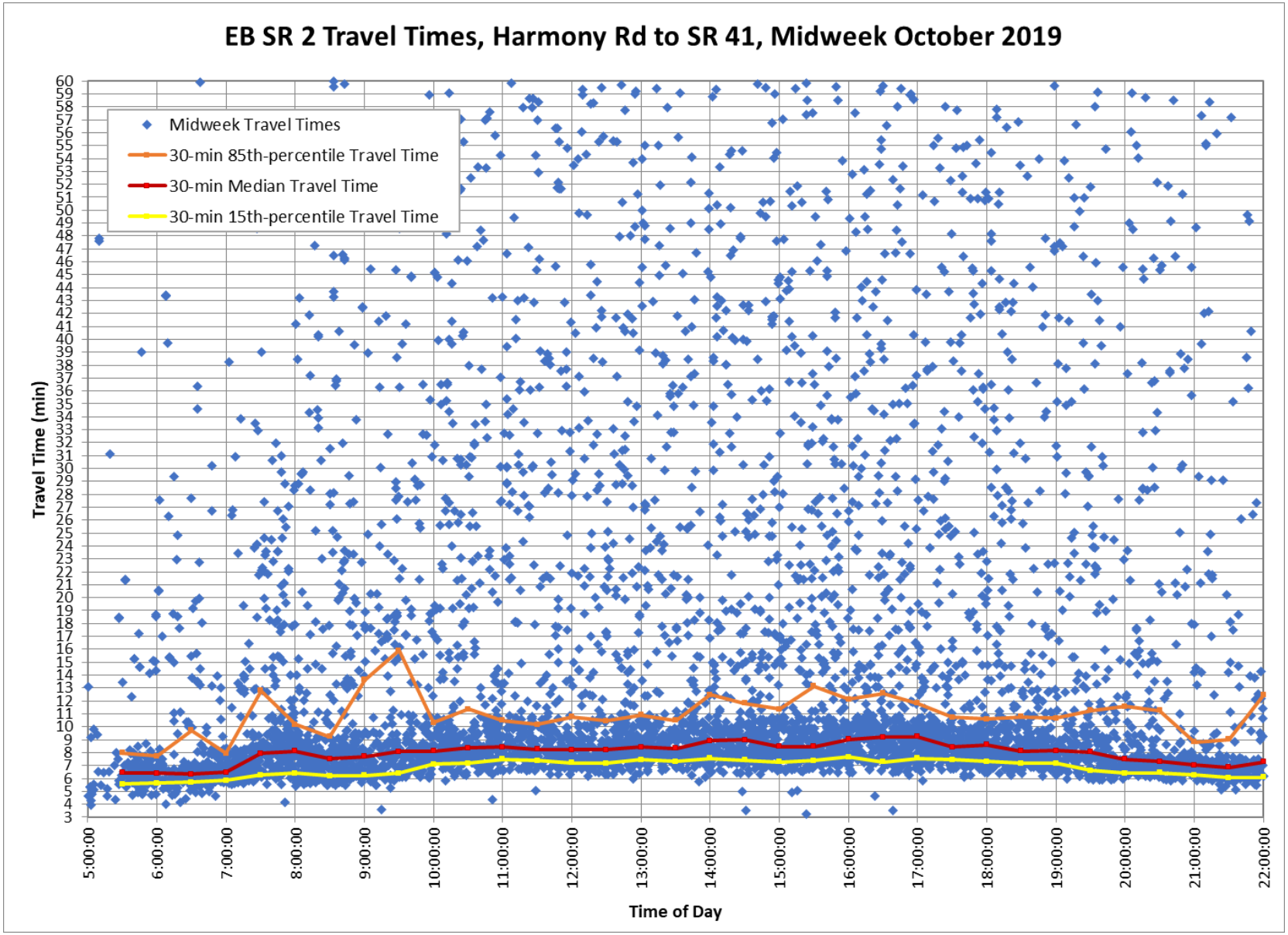
SR 48 Travel Times
Bluetooth Data



SR 48 Travel Times
RITIS Data



SR 2 Travel Times
Bluetooth Data



SR 2 Travel Times
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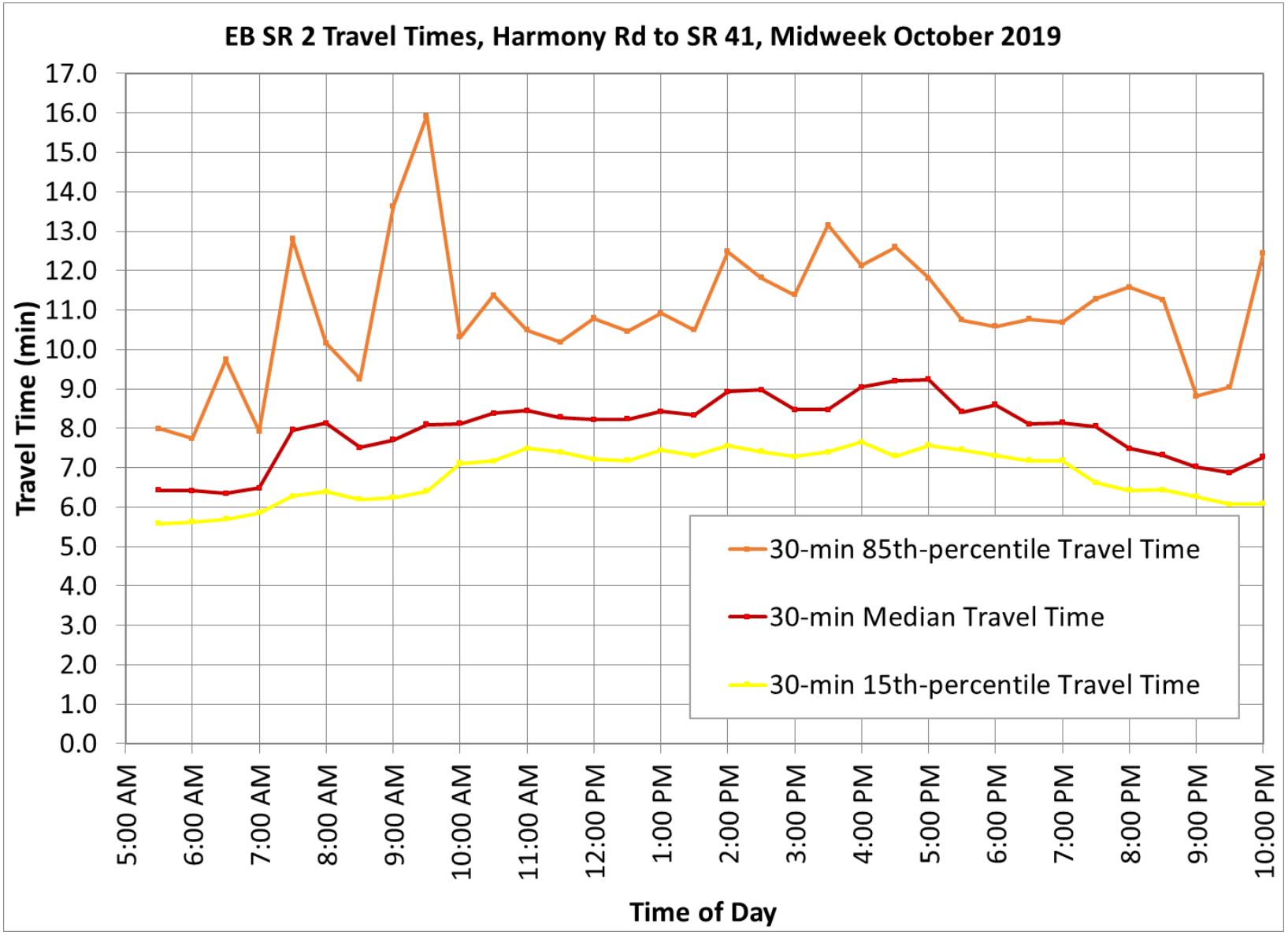

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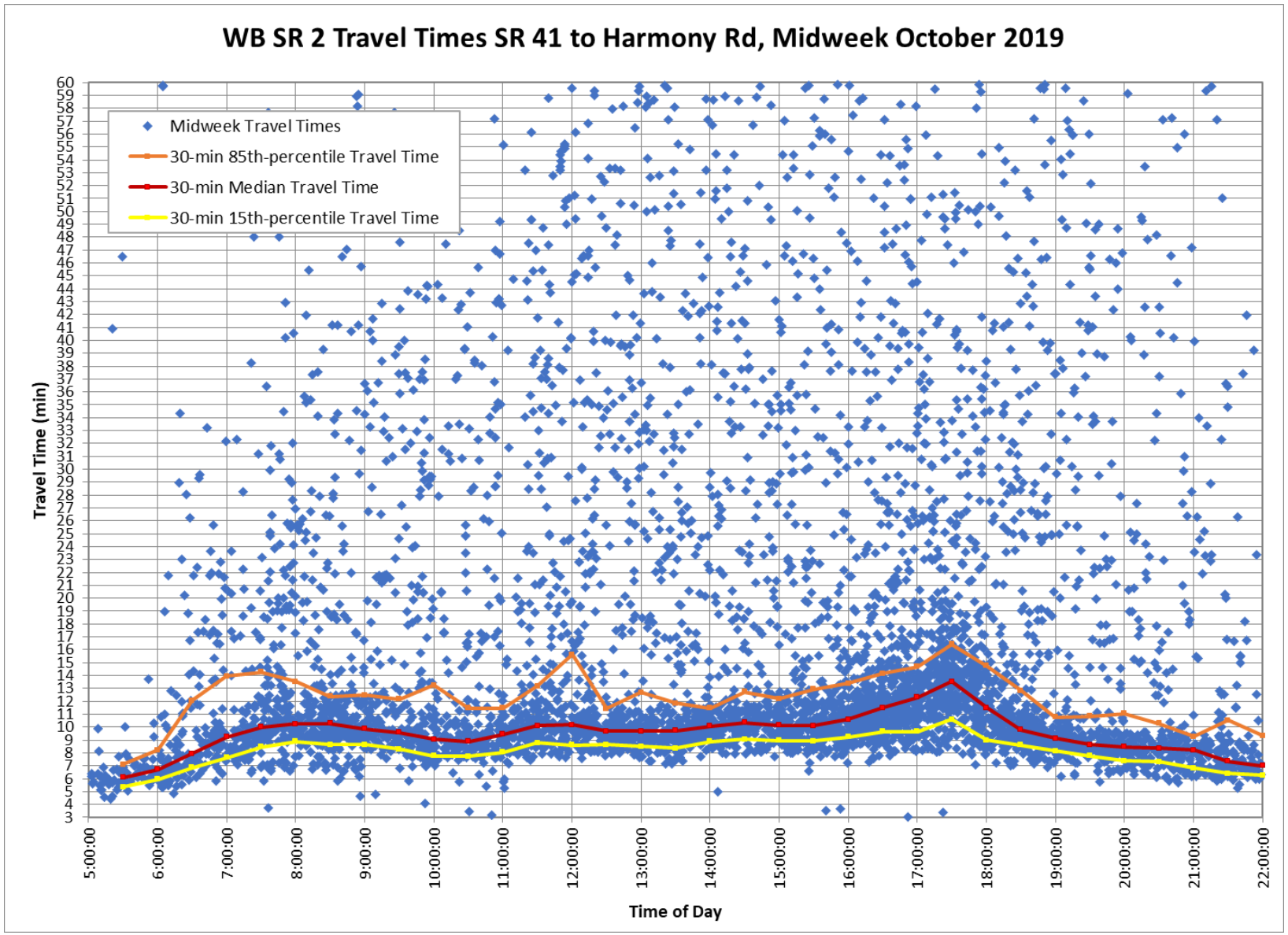
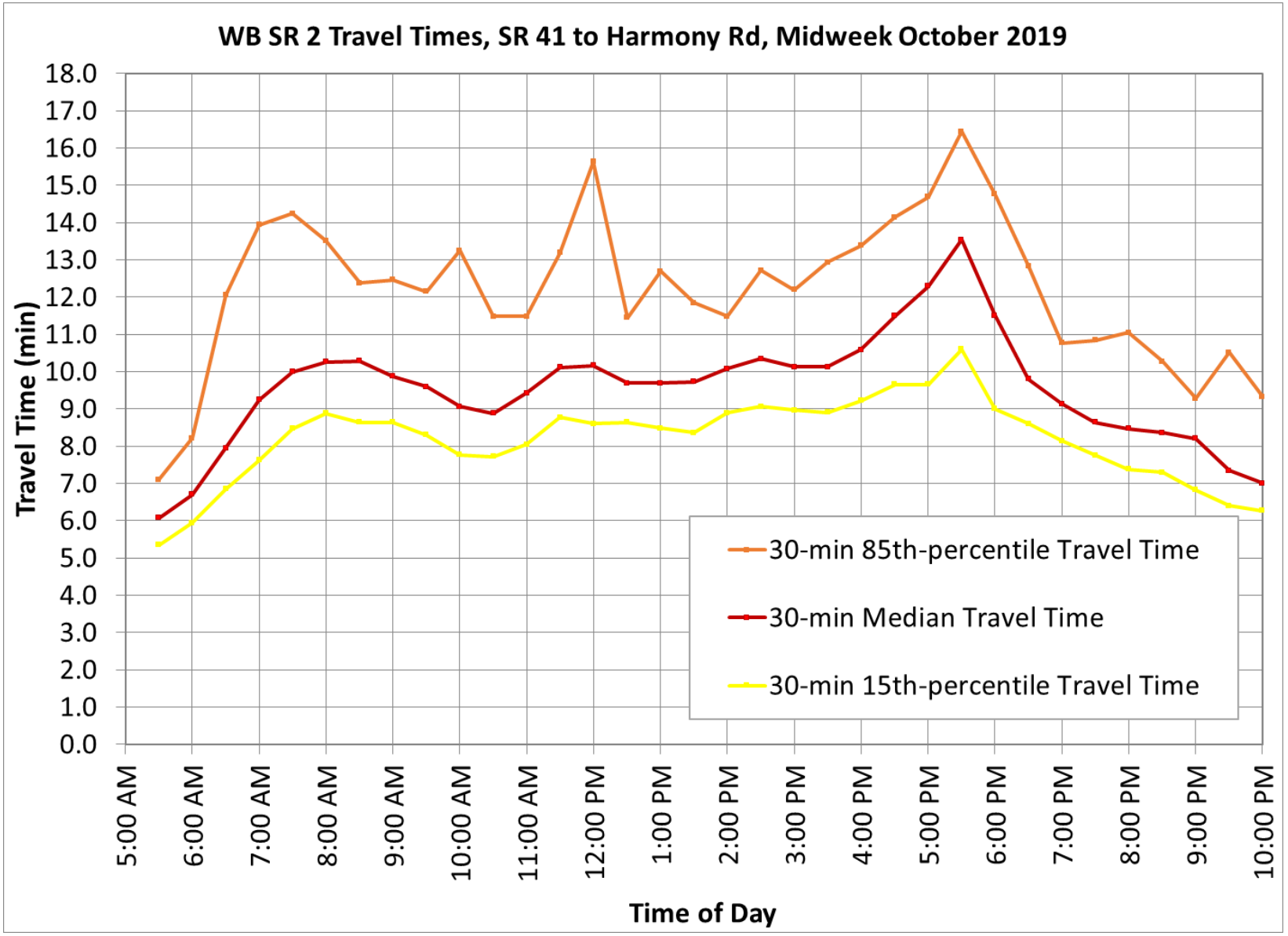
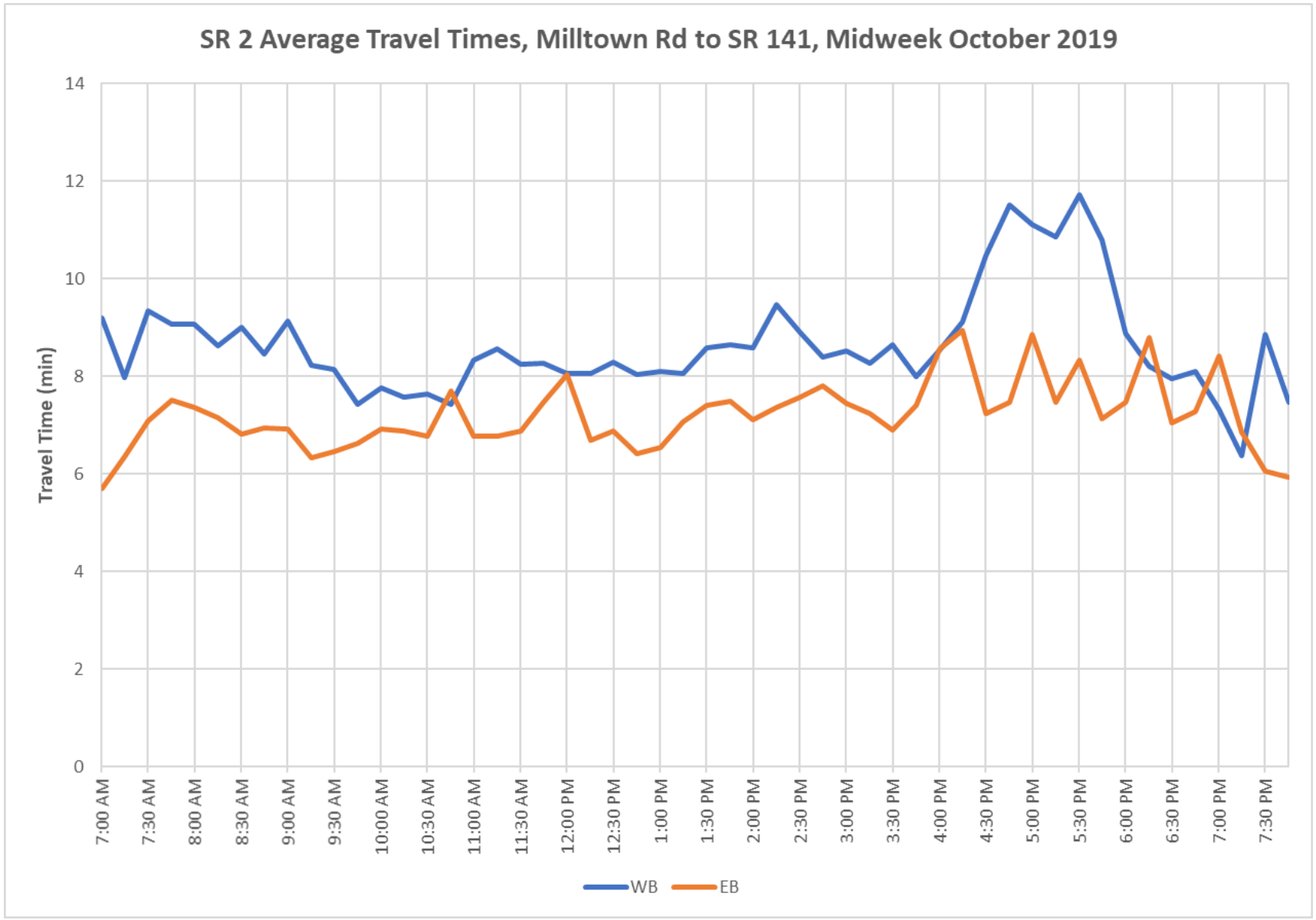


SR 2 Travel Times
Bluetooth Data



SR 2 Travel Times
RITIS Data



APPENDIX B – SIGNAL TIMING CORRIDOR FINAL REPORTS

Submitted to: DelDOT
Corridor: Delaware Route 7 North (Newark/Wilmington)
Date: June 2016

Background & Analysis:

The segment of SR 7 analyzed in this study included a total of 18 signalized intersections. The entire corridor is approximately 6.00 miles, with speeds of 40-50 mph. The corridor was broken up into five zones in order to best coordinate the signals. This corridor was identified as one of WILMAPCO's congested corridors in New Castle County. The corridor was initially studied in 2014 and again in 2016.

The analysis process included field reviews, before and after travel time runs, turning movement counts, CMS sheets, P2 sheets, and optimizing splits/offsets, green bands, cycle lengths, and time of day plans.

Results:

All current timings, offsets, and TOD plans were changed to improve coordination, delay, and travel times along the corridor. Other recommendations included improving pedestrian facilities and identifying intersections needing further analysis. The chart below shows the difference in green band times for each group from before and after changes were made. For more detailed results and recommendations, see *Delaware Route 7 North Corridor Signal Coordination Study*.

Green Band Times	AM Before	Mid Before	PM Before	AM After	Mid After	PM After
Zone N068	2/3/1 100 SB NB 8s SB 15s	3/3/1 120 SB NB 3s SB 41s	2/2/1 100 NB NB 20s SB 0s	2/3/1 100 SB NB 0s SB 41s	2/1/1 100 Bal NB 13s SB 11s	3/2/1 120 NB NB 36s SB 0s
Zone N036	4/3/1 150 SB NB 0s SB 12s	3/1/1 120 Bal NB 0s SB 27s	3/2/1 120 NB NB 0s SB 0s	3/3/1 120 SB NB 0s SB 46s		3/2/1 120 NB NB 36s SB 0s
Zone N035	4/3/1 150 SB	4/1/1 150 Bal	4/2/1 150 NB	4/3/1 150 SB	4/1/1 150 Bal	4/2/1 150 NB
Kirkwood	NB 0s SB 12s	NB 0s SB 27s	NB 0s SB 0s	NB 0s SB 54s	NB 17s SB 17s	NB 0s SB 0s

AM Avg. Corridor Travel Times (min)
- Jul 2013: 12.02 NB, 11.98 SB
- Dec 2014: 11.23 NB, 12.92 SB
- Jan 2016: 10.74 NB, 12.0 SB
- May 2016: 10.83 NB, 10.95 SB

Mid Avg. Corridor Travel Times (min)
- Jul 2013: 11.25 NB, 12.48 SB
- Jan 2016: 10.89 NB, 10.26 SB

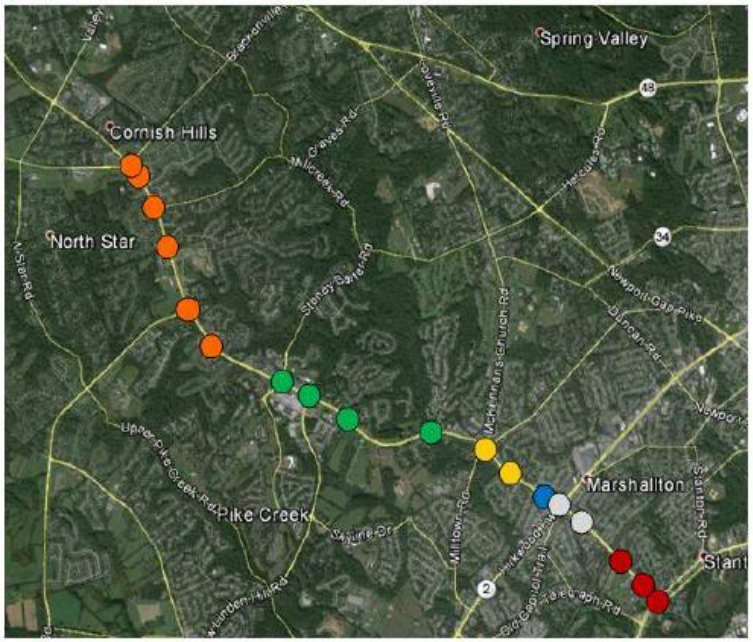
PM Avg. Corridor Travel Times (min)
- Jul 2013: 13.19 NB, 13.17 SB
- Dec 2014: 13.58 NB, 12.37 SB
- Jan 2016: 13.58 NB, 13.11 SB
- May 2016: 12.09 NB, 12.41 SB

SR 7 North was initially retimed as a corridor on 8/20/2014. Due to the results, the corridor timings were adjusted on 5/31/2015. SR 7 North was added to the 2016 corridors list due to continued issues and congestion along the corridor. The new timings were implemented on 4/7/2016. The 2016 efforts included coordination between zones, particularly with Kirkwood Highway to try to move traffic more efficiently through that intersection. Travel time runs were calculated along the way and can be seen in the boxes above. Overall, all travel time runs have decreased since the initial study in 2013 and coordination has

Executive Summary
Delaware Route 7 North

improved throughout the corridor. Since the initial study, AM travel time runs decreased by 11% in the NB direction and 9.5% in the SB direction. Midday travel time runs decreased by 3.3% in the NB direction and 22% in the SB direction. PM travel time runs decreased by 9% in the NB direction and 6% in the SB direction.

Current Zones



- Group 1 (Intersections 1-6: Valley Rd, Lantana Dr, Brackenville, Village Rd, Papermill Rd, Ocheltree)
- Group 2 (Intersections 7-10: Stoney Batter, New Linden Rd, Greenwood, Arundel Dr)
- Group 3 (Intersections 11, 12: Milltown/McKennans, Pickwick Dr)
- Group 4 (Intersection 13: Midway Shopping Center)
- Group 5 (Intersections 14, 15: Kirkwood Highway, Hendry Dr)
- Group 6 (Intersections 16-18: Tarry Ln, Jane Way, SR 4/7 Stanton Split)

Summary
SR 41 (Newport Gap Pike)

Pre-Implementation Summary

August 4, 2016

Background & Analysis:
This segment of SR 41 (Newport Gap Pike) was identified as part of DelDOT's signal corridor retiming project in January 2015. The corridor analyzed in this study included five existing signalized intersections, a length of approximately 2.6 miles. Two signals on SR 41 operated SYSTEM FREE, one signal operated as a member of Zone N108 (recently added due to widening project/signal rebuild), and two signals were added to DelDOT's signal system via CDMA installation. All five signals now operate as coordinated Zone N108.

The analysis process included field reviews, travel time runs, CMS analysis, previous turning movement count analysis, portable Wavetronix® data analysis, and *Synchro* analysis, which was used to optimize green bands and split times.

Results:
All current timings, offsets, and TOD plans were changed on May 24, 2016 (with some follow-up timing adjustments made on June 6, 2016) to improve coordination, delays, and travel times along the corridor. Zone N108 operates with 120-second and 100-second AM and PM peak cycle lengths, respectively, and runs 75-second weekday off-peak cycle lengths and 90-second weekend cycle lengths. The signals return to SYSTEM FREE operation overnight. Due to very low overnight traffic and the history and driver expectation of fully-actuated operation, FREE operation was recommended for overnight periods.

During the "before" condition, there was no existing coordination, existing MAX I times were relatively high, and there were multiple detection failures. Resolving these issues and bringing the signals onto a coordinated system yielded significant improvements to both corridor travel times, particularly in the southbound direction in general and northbound during the evening peak, as shown on the inset. The SR 41 zone runs the same cycle lengths as the SR 48/SR 41 Zone N004 for most of the day, so northbound coordination between Graves Road and SR 48 can also be established. Correspondingly, the northbound travel time runs included this link while the southbound travel time runs did not.

Observations after implementation confirmed that while the heavy northbound left at Milltown Road still experiences significant queuing, vehicles are able to complete the turn without waiting multiple cycles. No complaints have been received on this corridor since implementation.

BEFORE Average Corridor Travel Times (sec)
- AM: 401 NB (pred. ↓19%) / 464 SB (pred. ↓20%)
- MID: 343 NB (pred. ↓10%) / 358 SB (pred. ↓14%)
- PM: 451 NB (pred. ↓13%) / 447 SB (pred. ↓15%)

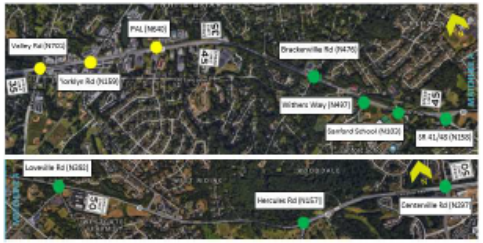
AFTER Average Corridor Travel Times (sec)
- AM: 390 NB (↓3%) / 242 SB (↓48%)
- MID: 335 NB (↓2%) / 250 SB (↓30%)
- PM: 373 NB (↓17%) / 257 SB (↓43%)

Average Intersection Delay (predicted)
- AM: ↓10% / MID: ↓21% / PM: ↓17%

DelDOT WRA Whitman Requardt & Associates, LLP 1915 100 YEARS 2015

Post-Implementation Summary

March 13, 2018



Background & Analysis:
This segment of SR 41 and SR 48 was identified as part of DelDOT's signal corridor retiming project in January 2017. The corridor analyzed in this study includes ten existing signalized intersections, a length of approximately 4.7 miles. Three signals operate as a part of Zone N065 (yellow), and seven operate as in Zone N004 (green).

The analysis process included field reviews, peak-hour turning movement counts, travel time runs, CMS analysis, previous turning movement count analysis, system loop data analysis, and *Synchro* analysis, which was used to optimize green bands and split times.

Results:
All current timings, offsets, and TOD plans were changed to improve coordination, delays, and travel times along the corridor. These changes were implemented on Thursday, December 7, 2017. Due to the differences in directionality between the western three signals (Valley Rd to PAL) and the rest of the corridor, the zone assignments were maintained.

The signal timings in Zone N065 were adjusted to increase the cycle length in the AM peak period from 90 to 100 seconds and decrease the cycle length from 120 to 100 seconds in the PM peak period. The signals in Zone N004 were programmed to increase the cycle length in the AM and PM peak periods (120 to 150 seconds in the AM and 100 to 120 seconds in the PM). Signals N497, N103, and N392 require cycle lengths in excess of 180 seconds in peak periods, so the cycle length for the entire zone was increased to help these signals accommodate demand.

Both zones run the same cycle lengths during the midday, overnight, and weekend periods. In the midday period, the cycle length was dropped from 90 to 75 seconds, and a 75-second cycle length was maintained in the overnight period. On the weekends, cycle lengths were kept constant, with 75-second cycles overnight and 90-second cycles during the day.

Signal N103 is pickled between approximately 7:25 and 7:55 each morning by crossing guards for Sanford School. The crossing guard has been observed to favor westbound traffic so buses can make a left turn into the school, and eastbound queues extended to Brackenville Rd on some days. Eastbound travel times have been observed to be 72% higher on the worst days than the average shown in the inset.

Average intersection delays were projected to decrease, despite increasing the cycle length in the peak periods in Zone N004. Actual corridor travel times decreased slightly in the AM peak period. In the PM peak period, the corridor was previously coordinated for eastbound traffic (greater travel times for westbound than eastbound), but westbound volumes are an average of 83% higher. These changes decrease travel time for that greater percentage of traffic. The eastbound travel time increases can be attributed to this coordination change and increased cycle lengths in Zone N004.

Average Intersection Delay (predicted)
- AM: ↓ 13% / MID: ↓ 9% / PM: ↓ 10%

BEFORE Average Corridor Travel Times (sec)
- AM: 546 EB / 488 WB
- PM: 476 EB / 540 WB

AFTER Average Corridor Travel Times (sec)
- AM: 536 EB (↓ 2%) / 473 WB (↓ 3%)
- PM: 586 EB (↑ 23%) / 497 WB (↓ 8%)

Summary
SR 2 (Kirkwood Highway)

Post-Implementation Summary

May 18, 2018

Background & Analysis:
SR 2 (Kirkwood Highway) was identified as part of DelDOT's signal corridor retiming project in January 2017. The corridor analyzed in this study includes 19 existing signalized intersections, a length of approximately 6.5 miles. Six zones are identified along this corridor and all were included in the analysis.

The analysis process included field reviews, peak-hour turning movement counts, travel time runs, CMS analysis, previous turning movement count analysis, system loop data analysis, and *Synchro* analysis, which was used to optimize green bands and split times.

Results:
All current timings, offsets, and TOD plans were changed to improve coordination, delays, and travel times along the corridor. These changes were implemented on Thursday, December 7th, 2017. Current zone configurations were looked at and only Duncan Rd switched zones due to higher vehicle demands (zone N032 to zone N031).

The signal timings in Zone N033 were adjusted to decrease the cycle length in the midday peak period from 120 to 100 seconds. The cycle lengths for the AM and PM peak periods were maintained. The signals in Zone N034, N032, and N031 all maintained the current cycle lengths for AM, midday, and PM peak periods.

Due to unexpected delays in construction, the after travel time runs were completed before construction was finished. It is recommended that a second set of after travel time runs is completed post-construction due to the increase in travel times, especially in the eastbound direction.

BEFORE Average Corridor Travel Times (sec)
- AM: 702 EB / 915 WB
- Mid: 706 EB / 737 WB
- PM: 883 EB / 919 WB

AFTER Average Corridor Travel Times (sec)
- AM: 750 EB (+ 6%) / 839 WB (- 9%)
- Mid: 766 EB (+ 8%) / 813 WB (+ 9%)
- PM: 909 EB (+ 3%) / 886 WB (- 4%)